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Stuart T. Danforth

This number of the Journal is affectionally dedicated

to the memory of

Dr. Stuart T. Danforth

who has contributed so much to our knowledge of the

birds of the West Indies, specially Puerto Rico

and who endeared himself to all with

who he came in contact.

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BIOGRAPHICAL SKETCH OF STUART T. DANFORTH 1900–1938

By ALEXANDER WETMORE.

Stuart Taylor Danforth, son of Ralph Emerson Danforth and Bertha T. Danforth, was born in Jersey City, New Jersey, September 23, 1900. According to information obtained from his parents he was a "born" naturalist, his interest in birds and in natural history in general beginning at a very early age. Taught to read and write by his mother, his notebooks recording his observations began at seven years when his parents removed to Ann Arbor, Michigan, where his father was engaged in advanced studies in zoology and botany in the University of Michigan. Books on nature were abundant in this household and these the growing boy devoured eagerly, their influence being evident in his care in his own records, in his accuracy of spelling, and in his arrangement of his observations.

Through his school and college days Danforth's interest in birds never lagged, his only regret being that he did not have more time to devote to such studies. In 1917 his father came to Rutgers University in the Department of Zoology and here Stuart Danforth took his undergraduate work. In zoology he was a student under his father, the class room relation between father and son being entirely on the formal basis of "Danforth" for the son and "Professor" for the father, in spite of the close and friendly relation that they had at home. His ability as a student is attested by his standing near the head in a large class, in spite of the father's confession that he undoubtedly marked him several points lower than he merited, in an intense desire not to be prejudiced in his classes in favor of his own son.

In 1921 when Stuart Danforth received his bachelor of science at Rutgers his father became head of the Department of Biology in the College of Agriculture and Mechanic Arts of the University of

Puerto Rico at Mayagüez, Puerto Rico. As Stuart was only twenty-one on recommendation of his professors he decided to work for a year before beginning his graduate work at Cornell, and taught in the Mayagüez High School, living at home with his parents. Naturally the birds of a new region were a major interest with him, and quite naturally this led later in work for his doctorate at Cornell, to a thesis assignment on a study of the ecology of the birds of Cartagena Lagoon, Puerto Rico. These studies involved months of observation in the field, in which his father was often associated, and laboratory work at a table assigned for his use in the laboratories under his father's direction at the college in Mayagüez. His degree of Doctor of Philosophy was conferred by Cornell University in 1925, and his thesis entitled "Birds of the Cartagena Lagoon, Porto Rico", was published immediately in the Journal of the Department of Agriculture (of Puerto Rico).

During the scholastic year of 1925 and 1926 Danforth was an instructor in biology at Temple University, and the following fall when his father returned to the United States he was appointed to his father's position of Professor of Zoology and Entomology in the College of Agriculture and Mechanic Arts at Mayagüez, a position that he held with distinction until his death. While occupied constantly during the school year with his classes and his students he improved every opportunity for work in the field. Naturally most of these efforts centered around Mayagüez and Cartagena Lagoon, but his trips extended over the island and included visits to the out lying islets of Desecheo and Mona. Vacation periods were given to more extended journeys in other regions. In all of this work he was usually accompanied by one or more of his students. His field investigations at their end had carried him through the Antillean area from Cuba along the chain of islands that extends to Trinidad.

The summer of 1926 he visited Jamaica, and during the following Christmas holidays he investigated the birds of St. Thomas, St. Croix and St. John. After the close of college in 1927 he traveled extensively in the Dominican Republic and Haiti, including Gonave Island, and the following December made a brief journey to St. Martin and St. Eustatius. The summer of 1931 was devoted to an extensive survey of St. Lucia, St. Kitts, Nevis and St. Thomas, and in 1933 at the same season he visited Cuba, Antigua and Barbuda. The Christmas holidays at the end of that year were given to St. Thomas, Tortola and Jost van Dyke. In June, 1934 he was again

in Cuba, on his way by auto to the United States, and at the end of December that year he collected in Culebra and adjacen islets.

The following summer, with V. Biaggi, he made an extended journey from June to August, beginning at St. Thomas and covering St. Kitts, St. Lucia, Grenada, the Grenadines, and Martinique. In December 1935, again accompanied by Biaggi, he visited Vieques Island, east of Puerto Rico. The year 1937 saw the most extensive of Danforth's explorations in the Lesser Antilles. Beginning at St. Thomas in January he visited St. Eustatius, Saba, Montserrat and St. Vincent, continuing to touch at many of the small islets that make up the Grenadines. In this journey he reached Trinidad, and then returned north to stop in Barbados. In June Biaggi joined him in Guadeloupe, and the two in company made collections on Guadeloupe, Desirade, Marie Galante and other islands.

Six summers during this period were occupied with visits to the United States in which he was accompanied by Ramos, Biaggi, or others of his students. Usually he brought up a car and used this in travel through the country. Much of the time in these journeys he was occupied in the study of specimens in museums and in the assembling of records from ornithological literature pertaining to the West Indies. In this way he gathered in an extensive card file records and data that gave him a complete list of the birds of the various West Indian Islands serving as a guide in his constant studies directed toward the extension of knowledge of the avifauna of this interesting region.

My own acquaintance with Stuart Danforth, which began when he was enrolled as a graduate student at Cornell, came through a mutual interest in the birds of Puerto Rico and a correspondence begun at this time continued until within a few days of his death. Our personal contact came during his work in the National Museum in Washington in the summer seasons that he spent in the United States, and fostered a friendship based on mutual attraction and an absorbing interest in ornithology.

In the course of his work Danforth gathered as specimens about three thousand birds, kept in his home in Mayagüez, representing one of the most important collections that has been made relating to the West Indies. This was the basis of his published work and of his comparative studies, and was given by him prior to his death to the U. S. National Museum to be preserved for work for the future. It is especially important for the rare species that it contains and for its records from many of the smaller islets from which specimens

have not heretofore been available. Following his death the collection was brought to Washington and incorporated in the National collections where each specimen is marked by a distinctive label bearing the statement "Stuart T. Danforth Collection".

While most active in studies of birds Danforth was deeply interested in entomology, especially in the Coleoptera where the Buprestidae were his favorites. He collected insects extensively, and though he published little on this subject many of his specimens are the basis of records in the "Insectae Borinquensis".

Like thousands of others Danforth was an enthusiastic philatelist and confessed of late that he had perhaps put more funds into his stamp collections than he properly should. Geography, mammalogy and herpetology also had appeal to him, and his collection of stamps and his extensive travels led to an interest in railroad and post office business methods. Add to this outline of his activities, a devotion to his teaching and to his students, a deep feeling for movements concerned with the establishment of world peace, and a sincere and simple belief in the Christian faith, and there will appear some picture of the man and his place and stature in life. His influence on his students was always such as to inspire in them a desire to excel in their work and to build in them character that they will carry all through life.

He was above the average in height, and rather slender, modest always in comportment, and of a sensitive, studios disposition. Although quiet he was a charming companion with alert interest in everything in the world about him. Never robust, his work at times was interrupted by illness, but this did not interfere with his plans for future investigations. At the beginning of December, 1937 the writer last saw Danforth in his house in Mayagüez where he was seriously ill, and spent two days with him looking through his collection of birds and talking over many problems of mutual interest. We had hoped to go afield as I wanted to visit Cartagena Lagoon with him but this was not possible under the circumstances. Although he recovered later to some extent he never regained his full health, and in May, 1938 his illness became acute so that he was forced to return to the United States. His death came on November 25, 1938 when he was under the care of his parents at West Boylston, Massachusetts.

His influence will long be felt in Puerto Rico where the esteem in which he was held is fittingly indicated in the following resolu-

tion signed by the Dean of his College in Mayagüez and by forty-two of his colleagues, fellow members of the faculty.

"To Ralph E. Danforth, Bertha T. Danforth and family for the death of their son and brother,

Stuart T. Danforth,

we, the Faculty of the College of Agriculture and Mechanic Arts of the University of Puerto Rico, send our sincere condolences and deepest sympathy.

Our colleague for more than twelve years, we have known Stuart T. Danforth as an indefatigable worker, a sound and creative scholar and scientist, a sympathetic teacher, insistent upon the highest standards from his students, a generous and loyal friend to all who were associated with him.

In his passing, Puerto Rico and the institution where he worked with us have suffered an irreparable loss. We shall miss his sorely.

His influence among us was a constant inspiration. May his warmth of personality, his character and his deep Christian faith keep that influence active through the future of our college and in our hearts."

Bibliography

Compiled by Alexander Wetmore and Herbert Friedmann

New Hampshire Mountain Notes. Oölogist **33**: 177, 1916.

New Hampshire Notes. Oölogist **34**: 30–31, 1917.

New Hampshire Notes. Oölogist **34**: 165, 1917.

(Untitled Short Note). Oölogist **35**: 44, 1918.

New Hampshire Notes. Oölogist **36**: 69, 1919.

New Hampshire Notes. Oölogist **37**: 2–4, 1920.

Some New Brunswick, N. J., Migration Records. Oölogist **38**: 7, 1921.

Some Birds Notes from the Pine Barrens, of New Jersey. Oölogist **38**: 7–8, 1921.

Some Impressions of Porto Rico Bird Life. Oölogist **39**: 10–11, 1922.

North American Migrants seen during a Winter in Porto Rico. Oölogist **39**: 176–178, 1922.

Christmas Bird Census, Cartagena Lagoon, Southwestern Porto Rico. Bird-Lore **26**: 52, 1924.

The Giant Kingfisher (*Ceyle torquata stictipennis*) in Grenada. Auk **41**: 343, 1924.

Short-billed Marsh Wren at New Brunswick, N. J. Auk **41**: 349, 1924.

Some Bird Notes from Jaffrey, N. H. Auk **41**: 352, 1924.

Birds Seen Between Porto Rico and New York. Wilson Bull. **37**: 76–77, 1925.

New Birds for Porto Rico. Auk **42**: 558–563, 1925.

Porto Rican Herpetological Notes. Copeia No. **147**: 76–79, 1925.

Birds of the Cartagena Lagoon, Porto Rico. Journ. Dept. Agric. Porto Rico, **10**: 1–136, 1926.

The Least Tern (*Sternula antillarum antillarum*) in Grenada. Lesser Antilles. Auk **43**: 363, 1926.

Christmas Bird Census, Guánica Valley, Porto Rico. Bird-Lore **29**: 52, 1927.

Christmas Bird Census, Cartagena Lagoon, Porto Rico. Bird-Lore **30**: 68–69, 1928.

Birds Observed in Jamaica during the Summer of 1926. Auk **45**: 480–491, 1928.

Birds Observed in the Vicinity of Santiago de Cuba. Wilson Bull. **40**: 178–182, 1928.

Snowy Plover in Haiti and Porto Rico. Auk **41**: 231–232, 1929.

Notes on the Birds of Hispaniola. Auk **41**: 358–375, 1929.

Notes on the Birds of St. Martin and St. Eustatius. Auk **42**: 44–47, 1930.

Birds Records from the Virgin Islands. Journ. Dept. Agric. Porto Rico **14**: 107–133, 135–150, 1930.

Puerto Rican Ornithological Records. Journ. Dept. Agric. Puerto Rico **15**: 33–106, 1931.

The Dwarf Cowbird (*Molothrus bonariensis minimus*) in St. Lucia. Auk **49**: 96–97, 1932.

A List of the Birds Known from Antigua, B.W.I. Leeward Islands Gazette, Suppl., Nov., 1933, pp. 1–4, 1933.

The Black Swift (*Nephoecetes niger niger*) in St. Croix. Auk **51**: 84, 1934.

Some West Indian Records of Charadriiformes. Auk **51**: 103, 1934.

Oyster-catcher and Western Sandpiper in the British Virgin Islands. Auk **51**: 233, 1934.

The Birds of Antigua. Auk **51**: 350–364, 1934.

A New Clapper Rail from Antigua, British West Indies. Proc. Biol. Soc. Washington **47**: 19–20, 1934.

Leach's Petrel in the West Indies. Auk **52**: 74, 1935.

The Birds of St. Lucia. Monographs Univ. Puerto Rico ser. B, no. **3**, 129 p., 1935.

Investigations concerning Cuban Birds, with Special Reference to the Economic Status and Considerations of those which might be Desirable for Introduction into Puerto Rico. Journ. Agric. Univ. Puerto Rico **19**: 421–437, 1935.

Supplementary Account of the Birds of the Virgin Islands, including Culebra and Adjacent Islands Pertaining to Puerto Rico, with Notes on their Food Habits. Journ. Agric. Univ. Puerto Rico **19**: 439–472, 1935.

The Birds of Barbuda, with Notes on their Economic Importance and Relationship to the Puertorican avifauna. Journ. Agric. Univ. Puerto Rico **19**: 473–482, 1935.

A New Ground Dove from the West Indies. Journ. Agric. Univ. Puerto Rico **19**: 483–484, 1935.

The Ruff in Grenada, B.W.I. Auk **53**: 80, 1936.

A Bird New to the West Indian Avifauna. Auk **53**: 82, 1936.

A West Indian Record for the Bay-breasted Warbler. Auk **53**: 89–90, 1936.

Scarlet Tanager in St. Lucia. Auk **53**: 90, 1936.

New Records for Mona Island, West Indies. Auk **53**: 100, 1936.

Invasion of Glossy Ibises in Puerto Rico. Auk **53**: 323, 1936.

The Birds of St. Kitts and Nevis. Trop. Agric. **13**: 213–217, 1936.

Los Pájaros de Puerto Rico. Rand, McNally & Co., New York & Chicago, 1936, small 8 vo., pp. I-X, 1–198, many illustrations (10 plates in color), 1936.

A Revision of the West Indian Races of *Loxigilla noctis* (Linnaeus). Journ. Agric. Univ. Puerto Rico **21**: 225–232, 1937.

Ornithological Investigations in Vieques Island, Puerto Rico, during December, 1935. Journ. Agric. Univ. Puerto Rico **21**: 539–550, 1937.

Key West Quail-dove in Puerto Rico. Auk **55**: 124–125, 1938.

Observations on some Barbadian Birds. Journ. Barbados Mus. Hist. Soc. **5**: 119–129, 1938.

The Races of *Oreopelia mystacea* (Temminck). Proc. Biol. Soc. Washington **51**: 73–74, 1938.

American Coot in Puerto Rico. Auk **55**: 528, 1938.

Recent Occurrence of the Flamingo in Puerto Rico. Auk **55**: 667, 1938.

The birds of Saba. Journ. Agric. Univ. Puerto Rico **22**(4): 503–512, 1938.

Gray-breasted Tree Duck in Puerto Rico. Auk **55**: 668, 1938.

——————— **& Bond, James.** Christmas Bird Census, Boquerón Valley, P. R. Bird-Lore **31**: 66, 1929.

——————— **& Danforth, R. E.** Christmas Bird Census, Mayagüez, Porto Rico. Bird-Lore **24**: 41, 1922.

——————— **& Emlen, John T., Jr.** A New Agelaius from Haiti. Proc. Biol. Soc. Washington **40**: 147–148, 1927.

——————— **& Smyth, J. Adgar.** The Puerto Rican Form of the Broad-winged Hawk. Journ. Agric. Univ. Puerto Rico **19**: 485–486, 1935.

THE BIRDS OF GUADELOUPE AND ADJACENT ISLANDS

By Stuart T. Danforth,
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Guadeloupe

Guadeloupe is the largest of the islands of the Lesser Antilles, having an area of about 583 square miles. It is situated in approximately 16° North latitude and 64° West longitude.

The Island in reality consists of two distinct islands, Guadeloupe proper (containing about 364 square miles) and Grande Terre (containing about 219 square miles) separated from each other by a shallow arm of the sea from 90 to 300 feet wide known as "La Rivière Salée", which is traversed by a highway bridge near Pointe-à-Pitre. The two islands are of very different formation and appearance. Guadeloupe proper is of volcanic formation, consisting mainly of a vast central mountain mass covered with virgin rain forest, much of which remains unexplored. The highest peak, known as the Soufrière, attains an elevation of 4,868 feet, and has a crater from which sulphur is obtained, and old lava flows may be observed near the crater. Although still feebly active, it has not erupted violently within historical times. The rain forest does not extend much above 4,000 feet, as the regions above that altitude are so windswept that only a very low type can exist, and practically no birds may be observed there. The rain forest extends down to about 2,000 feet elevation (or somewhat lower in some places). Below that is found second growth country, or, in the North and East of the Island, a beautiful rather low type of hardwood forest extending down to where cultivations begin, and reaching practically to sea level in some regions, as at Sainte Marie and Sainte Rose. The ever-increasing banana plantations are constantly encroaching upon this zone. Below this are the lowland savannas, largely planted to cane, at least in the South and East. On the West coast the corresponding area is somewhat less level and more barren, being covered mainly with a semi-xerophytic type of scrub where all except a very few species of birds are very scarce. Except for a small volcanic lake in the mountains, I know of no ponds in Guadeloupe

proper. There are a few mangrove swamps in the northeastern corner.

Grande Terre is of coral limestone formation, with only low hill formations, making a monotonous low, level, and dusty landscape. There are a few limestone sinkholes containing water where a few aquatic birds may be found, and some rather extensive mangrove swamps along the coast, particularly in the western part of the Island near Port-Louis and Vieux-Bourg.

Due to the writings of early travellers, there are some records of Guadeloupe bird life extending back to a very early date. For example, there is a record of an extinct macaw stated by Navaret to have been seen on Columbus' voyage of discovery. Huttich (1534), Dutertre (1674) and Père Labat (1742) have left records (in some cases very extensive) of their observations of Guadeloupe birds, and our only knowledge of various species now extinct is due to them.

Next in order of time comes the eminent resident naturalist, Dr. F. L. L'Herminier, who formed very extensive collections of birds from 1827 to 1844, and contemplated publishing a work on the ornithology of the Island. Unfortunately all his specimens and notes were destroyed in the great Pointe-á-Pitre fire of 1844, so that all we have left of his work are a few specimens (including the types of several species) he had sent to foreign ornithologists, and a nominal manuscript list, apparently written from memory after the fire, of 135 species he believed he had found in Guadeloupe. This list by indirect means got into Lawrence's hands, and he unfortunately published it verbatim (Proc. U.S.N.M., I, 1879, pp. 450–451). I say unfortunately, since Dr. L'Herminier's memory evidently failed him, resulting in the occurrence in this list of a highly improbable and chaotic assemblage of European, North American and South American birds, in addition to those known to occur only in other West Indian islands, and *nomina nuda*. On this account, most authors have completely disregarded the list when treating of the birds of the Island, while others have picked birds to list here and there according to their fancy, with no apparent rational basis for their choices, thereby greatly complicating the literature of the avifauna of Guadeloupe, and creating difficulties for future workers. It seems only reasonable that since all birds are treated alike in this list, one must adopt a consistent method, and either accept all or accept none of the birds in the list. The former course is clearly absurd, due to the many obviously highly improbable if

not impossible records, so I have decided upon the course of accepting no records from the list, and listing only birds of which there is some specimen from Guadeloupe extant, or a more or less definite record which does not obviously originate exclusively from this list. Therefore let the reader be not surprised at finding omitted from the annotated list certain species which have been listed by Bond, Ridgway, Bent, and other modern authors, which on being checked up apparently had no other basis of authority than L'Herminier's list.

Shortly after the Pointe-á-Pitre fire the Musèe L'Herminier was built, but it suffered serious damage in the hurricane of 1928, and had to be installed in new quarters afterwards. Much of the library was destroyed, but the birds were saved. In a large central glass-covered case there are a large number of birds said to be all from Guadeloupe, but otherwise completely without data, and I could not even ascertain who had obtained and prepared the specimens. However, they are of some antiquity, judging by their appearance, and by the fact that such species as the burrowing owl and clapper rail, which no longer exist in this region, are to be seen there.

Fred A. Ober, collecting for the Smithsonian Institution, worked in Guadeloupe in August and September 1878, leaving in October, and forwarded 132 specimens of birds. An annotated list of 45 species collected or recorded by him was published by Lawrence (Proc. U.S.N.M., I, Apr. 22, 1879, pp. 449–462).

There are in the U. S. National Museum a rather large number of old skins obtained in Guadeloupe by L. Guesde. These are all without further data, but they seem to be of comparable age to those in the Musée L'Herminier, and I am impelled to wonder if it might not have been the same person who prepared both. They were certainly obtained before 1885, as there is published mention of some of them dating back to that year.

Dr. St. Felix Colardeau, of Basse-terre, sent a number of specimens and notes to Lawrence during the period from 1882 to 1890, including the types of his *Chaetura dominicana colardeaui* and *Ceryle stictipennis*. Lawrence published an account of 10 species received from Dr. Colardeau, together with notes on their habits also received from him, in the Proc. of the U.S.N.M., 8, 1885, pp. 621–625.

W. B. Richardson, working for Cory, collected 76 specimens representing 15 species on Grande Terre in February, 1886. Cory pub-

lished a report on this collection in the *Ibis* for October, 1886, pp. 471–475.

C. S. Winch, also collecting for Cory, spent some time in August, September and October, 1890, working in Guadeloupe. He obtained a rather large number of specimens, representing 42 species, a nominal list of which was published in the *Auk* for January 1891 (pp. 47–49).

In 1894 Jules Ballet publishes a work entitled ''La Guadeloupe. Renseignements sur L'Histoire, La Flore, La Faune, La Géologie, La Mineralogie, L'Agriculture, Le Commerce, L'Industrie, La Législation, L'Administration'' in 3 volumes (Basse-Terre). The section on birds occupies pages 7–39 of the second volume; but little original information is offered.

In 1914 G. K. Noble, representing the Museum of Comparative Zoölogy, spent the period from June 22 to September 12 working on Guadeloupe. Later he published a rather extensive report on the resident birds of the island (Bulletin of the Mus. of Comp. Zoöl., 60, 1916, pp. 359–396), in which 46 resident species are discussed.

James Bond, representing the Academy of Natural Sciences of Philadelphia, spent a short time collecting in Guadeloupe early in 1930. He has published no complete report of his work in Guadeloupe although observations on the birds of the Island may be found in his ''Birds of the West Indies'' (1936).

M. Mimi published a chapter on the fauna of the island in ''La Guadeloupe du Tricentenaire'' (Basse–Terre, 1935). It is a good source for local names, but has only slight original information.

The present author made several short *in transit* visits to Guadeloupe, on which opportunity was always taken to observe birds, as on December 29, 1930 and June 18, 1931, but his real work there was done in 1937, with Virgilio Biaggi, Jr. as assistant, when the period from June 10 to July 26 was spent there, with the exception of a few days used for visiting neighboring islets. We had intended to spend a somewhat longer period in this region, working on Guadeloupe proper, and spending a week instead of the short time actually spent on Marie Galante, and making a trip to Petite Terre (to say nothing of spending two weeks or so in Martinique), when we were suddenly summoned back to Puerto Rico much in advance of the time we had planned on returning. To make matters even worse we had to leave earlier than would have otherwise been necessary on account of transportation facilities. During our stay we made observations upon 38 species of birds in Guadeloupe, includ-

ing Grande Terre. These were mostly breeding birds, as we were not in the season for many migrants. We collected 133 specimens representing 24 species there.

Les Saintes

Lying from six to eight miles directly south of Guadeloupe proper is a group of six small islands of volcanic formation known as Les Iles des Saintes. The two largest are Terre-de-Bas and Terre-de Haut; the other four are much smaller, and include Grand Ilet and Ilet á Cabrits. The total area of the entire group is only about 5½ square miles. By far the most interesting of the group is Terre-de-Bas, the most westerly of the islets. It is mostly hilly, the highest peak reaching an elevation of 932 feet. Part of the lowlands are cultivated, but the hills are covered with brush, and the higher parts support quite a luxuriant type of dry forest. The only water noted upon the Island consisted of a few stock-watering pools in which pond-lilies grew.

Terre-de-Haut has become a popular weekend and summer vacation resort for the more well-to-do people of Guadeloupe, but it is much less interesting than Terre-de-Bas from the naturalist's point of view. A large part of the Island consists of low pasture. The hills are in part covered with dry scrub, but there is no such luxuriant forest as on Terre-de-Bas. The highest peak (1,036 feet) is rocky and almost bare.

Noble obtained a few specimens from Les Saintes in September, 1914, but these were probably brought to him, as he makes no statement of having visited the islands, and includes many hearsay reports of birds occurring here gathered from fishermen.

Bonds writes me that he has visited the islands, and some birds records from here are included in his "Birds of the West Indies" (1936). His visit was presumably after 1930, as in that year he states (Proc. Acad. Nat. Sci, Phila., 82, 1930, p. 337) that the birds of Les Saintes "are at present completely unknown".

We visited Les Saintes on July 5, 1937, leaving Trois Rivières (on the mainland of Guadeloupe) very early in the morning in a sailing vessel with auxiliary motor which we had chartered for the day. We spent most of the morning on Terre-de-bas, and the afternoon on Terre-de-Haut (passing close to Grand Ilet on the way), returning to Trois Rivières in the evening. We observed 19 species of birds, and collected 15 specimens representing 10 species.

DÉSIRADE

Désirade is a long, narrow island of limestone formation situated about six miles east and slightly north of Pointe des Châteaux, the extreme eastern tip of Grande Terre. The sea in this region is so rough and the wind so contrary, and the landing so precarious, that the voyage is locally considered as very dangerous, and requires about 12 hours in small sailing vessels, which are the only regular means of transportation.

The Island consists mainly of a long, narrow, precipitously-walled plateau about 7 miles in length, and seldom much over a mile and a half in width. In most places there are some narrow strips of low, flat land intervening between the walls of the plateau and the sea, and near the town (Grande Anse) there is a small pond, which was practically dry at the time of our visit. The trail from the town to the plateau goes up the only available ravine, in parts of which there is considerable growth of xerophytic trees and bushes in which *Margarops* abounds. The top of the plateau is very level, and grown to tall brush, so that on the narrow path which traverses most of the length of it one can see but a short distance in any direction, and the heat is most oppressive due to the fact that one is so enclosed by the dense brush. The bare limestone protrudes through the earth so much that one treads it as much as the earth. The plateau reminded me much of that of Mona Island, but differed in its long, narrow shape, much greater elevation, and somewhat smaller proportion of protruding rock. Birds were decidedly scarce upon the plateau.

The first ornithologist to visit Désirade was W. B. Richardson, working for Cory, who collected there in March, 1886. The exact dates of his visit are not recorded, but in my notes I have annotations on specimens in the Field Museum collected from March 7 to 13, 1886. He collected 57 specimens representing 11 species, which were reported upon by Cory in the *Ibis* for October, 1886, pp. 471–475.

The second ornithologist known to have visited Désirade is Bond, who made a short visit during the latter part of January, 1930. He made some slight mention of Désirade birds in the Proc. Acad. Nat. Sci. Phila., 82, 1930, pp. 330 and 337, and other references to the birds of the Island are made in his "Birds of the West Indies".

Our visit to Désirade was made on July 9, 1937, when, thanks to the great kindness of the Governor of Guadeloupe, a customs patrol launch was placed at our service for the trip. With its powerful twin motors an ordinarily tedious and extremely uncomfortable trip

was made in rapid time with a minimum of discomfort. We left Pointe-á-Pitre at about 3 A.M., and arrived at Désirade by 8 A.M. The return trip was started at 5:30 P. M., and Pointe-á-Pitre was reached soon after 10 P.M. Charles Romney, a student of the University of Puerto Rico who was visiting relatives in Guadeloupe, accompanied us on this trip and devoted his time to collecting insects. During the day we made observations upon 15 species of birds, and brought back 13 specimens representing 9 species of birds, undoubtedly a smaller catch than we would have made if one of our guns had not most unfortunately broken down very early in the day.

Marie Galante

Marie Galante, the largest and most populous of the dependencies of Guadeloupe, is a roughly circular limestone island situated about 15 miles south of Grande Terre. It has an area of about 55 square miles, and possesses three towns (Grand-Bourg, Saint-Louis, and Capesterre). The main part of the Island consists of a plateau-like elevation (the highest point of which is 625 feet above sea level), but more rolling and less level than the plateaus of many limestone islands. Near the west coast there is some low marshy country of considerable extent, Ruounas Trois Islets where lowland birds abound. On the climb up the plateau one finds a few mango and other trees approximating woodland, but nothing that could be called a real forest. Trees are very scarce on top of the wind-swept plateau.

Burrowing owls were obtained from Marie Galante many years ago, the records do not show by whom. Possibly other older specimens, supposedly from Guadeloupe, are actually from here.

W. B. Richardson, collecting for Cory, visited Marie Galante in February and March, 1886. He obtained 67 specimens representing 13 species, which were reported upon by Cory (Ibis, 1886, pp. 471–475).

Bond writes me that he has visited the Island, but he has published no report of his visit.

We had intended spending a week on Marie Galante, but due to our unexpectedly early recall to Puerto Rico, this unfortunately had to be reduced to less than two days. But fortune was not all against us, as due to our obtaining the cooperation of M. Marcel Balastide, a resident sportsman with a car, and a thorough knowledge of the country and its birds, we were enabled to visit a large proportion of the best bird country in the limited time available.

We went to Marie Galante on July 17, 1937, on the weekly trip

of the mail sloop equipped with auxiliary motor "Père Labat", which makes the trip from Pointe-á-Pitre to Grand Bourg in slightly over four hours, and returned in the same vessel the following afternoon, embarking from Saint-Louis to save an hour of precious time on the Island. Charles Romney accompanied us and collected insects. We made observations upon 18 species of birds, and obtained 17 specimens representing 14 species.

Acknowledgments

To His Excellency, the Governor of Guadeloupe, M. Mené, we are greatly indebted for permission to collect in the closed season (something very difficult of attainment in this Island), and also for graciously facilitating us with the means of visiting Désirade.

A very special debt of gratitude is owed to M. Gilbert Chatelain, Chief of the Service des Eaux et Forêts, without whose truly friendly and cordial interest our work in these islands would have been a failure. It was due to his intercessions on our behalf that all government cooperation with our work was obtained, and in addition he assisted us personally in many ways, and a personal friendship was developed which has continued after we left the Island.

M. Marcel Party, proprietor of the Hotel Dolé-les-Bains, assisted us in many ways. He is a sportsman, and on occasions accompanied us in the field, and on others provided us with transportation to likely collecting grounds.

To M. Marcel Balastide of Marie Galante we are indebted for the most efficient way he, after ascertaining the aims of our visit, personally managed our activities in that Island to make the most of a short visit.

Notes on the Avifauna

As will be seen by the following annotated list, 91 forms are known from the area covered by this paper. Only reasonably certain records are included, all records for which the only basis is L'Herminier's list (see *ante*) being excluded. However, the evidence for some of the forms admitted to the list is not completely satisfactory, but since the evidence is given in each case, the reader may decide for himself how much value to place upon it. Also, since this list is confined to modern birds, records of the various extinct Psittaciformes which are not known from specimens are not included.

Of the 91 forms known from the region, 88 are recorded from Guadeloupe. Of these, 2 are here recorded for the first time.

From Les Saintes 25 species have been recorded, some on rather doubtful evidence. Ten species are here recorded as new.

The Désirade list totals 20, of which 5 are here first recorded.

From Marie Galante 22 species are known, of which 7 are listed here for the first time.

Annotated List

Podilymbus podiceps antillarum Bangs

ANTILLEAN PIED-BILLED GREBE

Chien d'Eau

Guadeloupe: Apparently very rare. Noble obtained an adult and two downy young at the Grand Étang, Cluny, in July 1914. On July 16, 1937 we observed an adult at a limestome sinkhole near Sainte Anne, Grande Terre.

Puffinus lherminieri lherminieri Lesson

AUDUBON'S SHEARWATER

Diablotin

Guadeloupe: Murphy (Oceanic Birds of South America, 1936, p. 684) mentions skins in the American Museum of Natural History taken in Guadeloupe in May.

Pterodroma hasitata (Kuhl)

BLACK-CAPPED PETREL

Diablotin

Guadeloupe: Formerly nested in the mountains, but not recorded for many years, and possibly extinct.

Phaëthon aethereus mesonauta Peters

RED-BILLED TROPIC BIRD

Paille-en-queue

Guadeloupe: Listed by various authors. It was reported to Noble as nesting at Tête Anglais, and Bond observed it was Guadeloupe.

Les Saintes: Fishermen reported it to Noble as nesting. On July 5, 1937 we observed a number nesting on the cliffs at Terre-de-Bas.

Désirade: The field Museum has a male obtained March 10, 1886 by Richardson.

Sula leucogaster leucogaster (Boddaert)

BOOBY

Fou Noir

Guadeloupe: Fishermen reported it to Noble as nesting at Tête Anglais.

Les Saintes: Reported to Noble as nesting.

Désirade: One seen off the coast July 9, 1937.

Sula sula sula (Linnaeus)

RED-FOOTED BOOBY

Fou Blanc

Guadeloupe: Fishermen reported it to Noble as nesting at Tête Anglais.

Les Saintes: Reported to Noble as nesting. It is doubtful if the species is still to be encountered in this region.

Phalacrocorax auritus floridanus (Audubon)

DOUBLE-CRESTED CORMORANT

Guadeloupe: Rare straggler. There is an immature specimen in the British Museum obtained by Admiral A. H. Markham.

Fregata magnificens rothschildi Mathews

MAN-O-WAR BIRD

Frégate

Guadeloupe: Fairly common along the coast; observed at Basse-terre, Malendure, Bouillante, La Boucan, Port-Louis and Vieux-Bourg (Grande Terre) in 1937. Said to breed on Tête Anglais.

Les Saintes: One observed at Terre-de-Haut and one at Terre-de Bas on July 5, 1937. Not previously recorded.

Ardea herodias adoxa Oberholser

WEST INDIAN GREAT BLUE HERON

Crabier Rada

Guadeloupe: There are two specimens in juvenile plumage obtained by L. Guesde in the U. S. National Museum.

Florida caerulea (Linnaeus)

LITTLE BLUE HERON

Crabier

Guadeloupe: Although this as well as both the egrets have been recorded based on L'Herminier's list, the first positive record for the island is apparently that recorded by May T. Cooke (Bird-banding, 9, 1938, p. 81) of an individual banded at Glen Allan, Miss., on May 24, 1936, and killed at Saint-Francois, Grande Terre, on September 30, 1936. This raises the problem of whether or not the Little Blue Herons resident in the West Indies constitute a distinct race (*caerulescens*) supplemented by migratory individuals of the typical race from the continent or not. The material at hand is too scanty to determine this point.

An individual in pied transition plumage was observed at Port-Louis, Grande Terre on July 8, 1937.

Butorides virescens maculatus (Boddaert)

WEST INDIAN GREEN HERON

Quio

Guadeloupe: Common and well known. An adult male collected at Dolé on June 17, 1937 had eaten three fresh water shrimps, and the stomach of an immature male from Sainte Anne, Grande Terre, July 16, 1937 contained 6 adult dragonflies, *Lepthemis vesiculosa.* The adult male measured, length 462; wing 176.6; tail 54.5; exposed culmen 58.4, and tarsus 47 millimeters.

Les Saintes: Noble obtained 6 specimens the first week in September, 1914. On July 5, 1937 we observed single individuals at stock watering ponds on both Terre-de-Bas and Terre-de-Haut.

Désirade: One observed at the nearly dry pond on July 9, 1937. Richardson obtained the species in 1886.

Marie Galante: An adult male from Saint-Louis, July 18, 1937

constitutes the first record for the island. It measures, length 450; wing 166; tail 56.4; exposed culmen 62.1; tarsus 45 millimeters. Its stomach contained a damselfly, a crayfish, 2 small weevile (*Tyloderma* sp.), and some miscellaneous insect fragments.

Nyctanassa violacea (Linnaeus)

YELLOW-CROWNED NIGHT HERON

Crabier

Guadeloupe: Obtained by Ober, and Noble records it as breeding east of Sainte Rose.

Phoenicopterus ruber Linnaeus

FLAMINGO

Flamant

Guadeloupe: Clark (Auk, 1905, p. 318) records the flamingo as occurring formerly south to Guadeloupe.

Dendrocygna autumnalis discolor Sclater and Salvin

GRAY-*breasted* TREE DUCK

Guadeloupe: Noble believes he saw one July 22, 1914 on a pond near Cluny.

Dafila bahamensis bahamensis (Linnaeus)

GRAY-BREASTED TREE DUCK

Canard Tête-blanche

Guadeloupe: Listed by Lawrence. Mimi (Guad. du Tricentenaire, 1935, p. 137) also mentions it.

Nyroca affinis (Eyton)

LESSER SCAUP DUCK

Canard Sauvage

Guadeloupe: There are no published records, but an unlabelled mounted female is exhibited in a case of birds all of which are supposed to be from Guadeloupe in the Musée L'Herminier. Undoubt-

edly this and various other migratory ducks, a number of which were listed by L'Herminier, occur occasionally during the winter months.

Erismatura jamaicensis jamaicensis (Gmelin)

WEST INDIAN RUDDY DUCK

Guadeloupe: There is no published record, but in a case of mounted birds all supposed to be from Guadeloupe in the Musée L'Herminier there are two unlabelled mounted females, and on July 16, 1937 at a limestone sinkhole near Sainte Anne, Grande Terre, we collected a female. It measured: culmen 42.5; breadth of bill at widest part 23.6; wing (arc) 135; tarsus 32.8, and tail 73.5 millimeters.

Nomonyx dominicus (Linnaeus)

MASKED DUCK

Guadeloupe: Although there is no published record other than that of L'Herminier, I am admitting the species to this list on the basis of a mounted specimen in a case of birds supposedly all from Guadeloupe in the Musée L'Herminier.

[*Buteo platypterus* subsp.

BROAD-WINGED HAWK

Guadeloupe: Of doubtful occurrence. Noble (Bull. M. C. Z., 60, 1916, p. 362) states that it has been seen by Pointe-á-Pitre sportsmen, and he considers it a straggler.]

[*Buteogallus anthracinus cancrivorus* (Clark).

BLACK HAWK

Guadeloupe: Listed here hypothetically on the basis of a statement by Noble (Bull. M. C. Z., 60, 1916, p. 362) that it has been observed by Pointe-á-Pitre sportsmen.]

Falco peregrinus anatum Bonaparte

DUCK HAWK

Gligli Montagne

Guadeloupe: I list this species with some hesitation, as all rec-

ords except that of Mimi (Guadeloupe du Tricentenaire, 1935, p. 135) apparently originate from L'Herminier's list, and that is indefinite.

Falco columbarius columbarius Linnaeus

PIGEON HAWK

Gligli Montagne

Guadeloupe: What I have said of the Duck Hawk applies verbatim to this species also.

Falco sparverius caribaearum Gmelin

ANTILLEAN SPARROW HAWK

Gligli

Guadeloupe: Previous collectors have recorded it as common. In 1937 we found it only fairly common on Guadeloupe proper, where it was observed at Dolé, Sainte Marie, Sainte Rose, Bonne Mere, and the hills behind Goyave, and none were seen on Grande Terre. A female collected at Dolé on June 17 had eaten two green *Anolis* lizards.

Les Saintes: Noble obtained a specimen. Commoner than on Guadeloupe. The stomach of a female collected on Terre-de-Bas July 5, 1937 contained a large *Anolis* lizard and 7 large pieces of gravel, while another female taken on Terre-de-Haut the same day had eaten a centipede and a ground lizard (*Ameiva*).

Désirade: Collected by Richardson in 1886. On July 9, 1937 five were observed on top of the plateau, and a female was collected. Its stomach contained short-horned grasshoppers.

Marie Galante: Collected by Richardson in 1886.

Colinus virginianus virginianus (Linnaeus)

BOB-WHITE or QUAIL

Guadeloupe: According to Phillips (U.S.D.A. Tech. Bull. 61, 1928, p. 31) the species was introduced in Guadeloupe about 1886–87. Apparently it was soon exterminated, as there are no further records.

Rallus longirostris manglecola Danforth

ANTIGUA CLAPPER RAIL

Pintade Maronne

Guadeloupe: Apparently formerly not uncommon, as there are 7

unlabelled specimens supposedly from Guadeloupe (one of which is immature) in the Musée L'Herminier. Noble stated that in 1914 the species had apparently been extirpated by the mongoose, not having been taken by the native chasseurs for a long time. An extensive search of all likely mangrove swamps we could locate failed to reveal any of these rails in 1937. Measurements were taken of the 6 adult specimens in the Musée L'Herminier. The culmen from base ranged from 63.3 to 73 millimeters (average 67.1) and the tarsus from 47.3 to 51.6 (average 49.4), thus agreeing well in size with specimens from Antigua. There is an immature specimen said to have been collected in Guadeloupe by Ober in the U. S. National Museum.

Ionornis martinica (Linnaeus)

PURPLE GALLINULE

Poule d'eau á Cachet Vert

Guadeloupe: Apparently extremely rare. The only definite record I find is of an adult purchased by Noble at Le Moule, Grande Terre, taken in 1913.

Gallinula chloropus portoricensis Danforth

ANTILLEAN GALLINULE

Poule d'eau á Cachet Rouge

Guadeloupe: There are numerous old records, but Noble considered the species almost extinct in Guadeloupe in 1914. He obtained a pair. We observed none in 1937.

Marie Galante: Collected by Richardson in 1886. In 1937 we observed two and collected a male in a sluggish stream at Saint Louis on July 18. Its stomach contained fragments of mollusc shells and seeds.

Fulica caribaea Ridway

CARIBBEAN COOT

Poule d'eau á Cachet Blanc

Guadeloupe: There are two specimens in the U. S. National Museum taken many years ago by Guesde.

Haematopus palliatus prattii Maynard

BAHAMAN OYSTER-CATCHER

Casse-Burgeau

Guadeloupe: In the Musée L'Herminier there are four unlabelled mounted specimens presumably from Guadeloupe. The culmen from base of these specimens measured 83, 85.5, 89.9 and 92.3 millimeters. In the U. S. National Museum there is a specimen taken on Guadeloupe by Guesde.

Pluvialis dominica dominica (Müller)

GOLDEN PLOVER

Guadeloupe: Listed by Ober.

Charadrius semipalmatus Bonaparte

SEMIPALMATED PLOVER

Guadeloupe: There is an adult male in the British Museum collected on September 6, 1890 by Winch. Ober also obtained a specimen.

Totanus melanoleucus (Gmelin)

GREATER YELLOWLEGS

Clinclin

Guadeloupe: One was observed at Port-Louis, Grande Terre on July 8, 1937. Although this and various other unlisted shorebirds are probably of common occurrence, there was no definite previous record.

Tringa solitaria solitaria Wilson

SOLITARY SANDPIPER

Guadeloupe: Obtained by Ober in 1878 and by Winch in 1890.

Actitis macularia (Linnaeus)

SPOTTED SANDPIPER

Branle-queue

Guadeloupe: First recorded by Colardeau. The Field Museum has a female collected August 12, 1890 by Winch. Noble found it early in July, and on that account believed it to be resident. We observed two at Port-Louis, Grande Terre on July 8, 1937.

Limnodromus griseus griseus (Gmelin)

EASTERN DOWITCHER

Becasse Grise

Guadeloupe: Lincoln (in Book of Birds, II, 1937, p. 352) records a specimen banded at North Eastham, Massachusetts on July 31, 1935, and captured at Pointe-á-Pitre on August 26, 1935. All other records, except possibly that of Mimi, apparently originate from L'Herminier's list.

Ereunetes pusillus (Linnaeus)

SEMIPALMATED SANDPIPER

Guadeloupe: Listed by Ober in 1878. The Field Museum has a female collected September 11, 1890 by Winch.

Pisobia minutilla (Vieillot)

LEAST SANDPIPER

Guadeloupe: Listed by Ober. The Field Museum has three males and a female collected by Winch on September 4, 1890.

Pisobia melanotos (Vieillot)

PECTORAL SANDPIPER

Guadeloupe: Listed by Ober. The British Museum has a female collected September 2, 1890 by Winch.

Larus atricilla Linnaeus

LAUGHING GULL

Pigeon de Mer

Guadeloupe: Apparently not very common on the coasts of Guadeloupe. Recorded by Ober. The British Museum has an adult male collected in August 1890 by Winch. Noble observed a few near Goyave in the latter part of August 1914. We observed none in 1937.

Sterna hirundo hirundo Linnaeus

COMMON TERN

Petite Mauve

Guadeloupe: Sent by Dr. Colardeau to Lawrence in 1885.

Sterna dougalli dougalli Montagu

ROSEATE TERN

Mauve á Bec Noir

Guadeloupe: Winch collected a series September 20–24, 1890, which is now in the British Museum. Noble reports it as seen rarely along the coast of Guadeloupe, and as reported by fishermen to breed on Tête Anglais.

Les Saintes: Fishermen reported it to Noble as breeding on Les Saintes, and he obtained an adult female there on September 10, 1914. We observed many, apparently nesting, on Terre-de-Bas and Grand Ilet on July 5, 1937.

Marie Galante: We observed five along the west coast on July 17, 1937, and two at Saint Louis the following day. Not previously recorded from the island.

Sterna anaetheta melanoptera Swainson

BRIDLED TERN

Mauve á Manteau Noir

Guadeloupe: The British Museum has an adult male and three inmature specimens taken by Winch in September, 1890.

Sterna fuscata fuscata Linnaeus

SOOTY TERN

Mauve á Manteau Noir

Guadeloupe: Ober obtained a full grown young in 1878. Fishermen reported it to Noble as breeding on outlying islets. On July 9, 1937 we observed thousands breeding on Le Souffloeur, a rock off the extreme eastern point of Grande Terre, while passing in a motor launch. Possibly there were a few Bridled Terns among them, but all which could be seen distinctly enough for satisfactory identification were this species. Some were seen at sea about half way from there to the island of Désirade.

Les Saintes: Noble obtained an adult female on September 10, 1914. On July 5, 1937 we observed three at Terre-de-Haut.

Sterna albifrons antillarum (Lesson)

LEAST TERN

Petite Mauve

Guadeloupe: **Obtained by Winch in 1890.**

Thalasseus maximus maximus (Boddaert)

ROYAL TERN

Guadeloupe: Listed by Ober, and reported to Noble as breeding on Tête Anglais.

Les Saintes: Fishermen told Noble it nests. However, its nesting anywhere in the Guadeloupe region is a matter of considerable doubt.

Anoüs stolidus stolidus (Linnaeus)

NODDY TERN

Mwen. Minine.

Guadeloupe: Collected by Winch in 1890. Noble reported it as rare about the mainland of Guadeloupe, but as reported to breed on Téte Anglais.

Les Saintes: Reported to Noble as breeding. On July 5, 1937 we found it nesting commonly on Grand Ilet and on the cliffs on Terre-de-Bas, and observed a few (apparently not nesting) around Terre-de-Haut.

Columba leucocephala Linnaeus

WHITE-CROWNED PIGEON

Ramier á Tête Blanche

Guadeloupe: Apparently a rare and irregular visitor. Rigdway's record seems to be based on L'Herminier, but Mimi mentions the bird, and it was reported to Noble as being occasionally seen after hurricanes.

Columba squamosa Bonnaterre

SCALED PIGEON

Ramier

Guadeloupe: This is the most important game bird of the island, being killed in large numbers every year by sportsmen and market hunters, bringing rather high prices. At the time of our visit the standard price was 7 francs (then nearly 35 cents). It is found most abundantly in the rain forests, although it also occurs in the lower wooded hills. We found it less common than in many nearby islands, probably due to the greater persecution it receives here.

Les Saintes: On July 5, 1937 a few were observed on Terre-de-Haut, and it was common on the mountain on Terre-de-Bas. Not previously recorded.

Marie Galante: Five seen at Trois Islets and three at Saint Louis on July 18, 1937. Not previously recorded.

Zenaida aurita aurita (Temminck)

MARTINIQUE DOVE

Tourterelle

Guadeloupe: Common in lower regions of second growth woods. We observed it at Dolé, Goyave, Sainte Marie, and Vieux-Bourg (Grande Terre).

Les Saintes: 10 seen on Terre-de-Haut July 5, 1937 constitute the first record.

Désirade: On July 9, 1937 we observed 10. Not previously recorded.

Marie Galante: Ten observed and a male collected at Trois Islets on July 18, 1937. Its crop was crammed with an enormous number of Bignoniaceous seeds, and 2 fruits of *Solanum bahamensis.* Not previously recorded from the island.

Columbigallina passerina nigrirostris Danforth

ST. KITTS GROUND DOVE

Ortolan

Guadeloupe: Common and well known. We found it much more common on the west than on the east coast of Guadeloupe proper, being particularly abundant from Vieux Habitants to Malendure. On Grande Terre it was locally common. Females were collected at Dolé June 23; Goyave July 2; Malendure July 4; Vieux-Bourg, Grande Terre July 13, and Le Moule, Grande Terre, July 16, 1937. All had the bill entirely dusky. All the crops were filled with small seeds, among which those of Euphorbeaceae figured prominently.

Les Saintes: Fairly common on Terre-de-Bas and ten were seen on Terre-de-Haut on July 5, 1937. A male collected on Terre-de-Bas had a completely dusky bill. Not previously recorded.

Désirade: Collected by Richardson in 1886. On July 9, -937 we found it common, and collected an immature male and an adult female, both with dusky bills. Not previously recorded.

Oreopeleia mystacea mystacea (Temminck)

BRINDLED QUAIL DOVE

Perdrix Croissant

Guadeloupe: Obtained by most collectors. Richardson obtained it on Grande Terre in 1886, where it is doubtful if it occurs at present. Noble found it locally abundant, and collected 15 specimens in

1914. In 1937 we observed a few at Sainte Marie on various dates, and collected a female on June 30. Its crop contained two large nuts and some soft fruits. We also recorded the species at Bananier and Sainte Rose.

Les Saintes: Recorded by Bond. We observed three on the higher parts of the mountain of Terre-de-Bas on July 5, 1937.

Désirade: Listed by Bond.

Oreopeleia martinica (Linnaeus)

MARTINIQUE QUAIL DOVE

Perdrix Rouge (male); Perdrix Gris (female)

Guadeloupe: Formerly abundant, but Noble considered it to be the rarest bird in Guadeloupe in 1914. He obtained one specimen at Goyave. In 1937 we observed a female in the mountains west of Bonne Mere on July 15.

Coccyzus minor dominicae Shelley

SHELLEY'S MANGROVE CUCKOO

Coucou Manioc. Oiseau de Pluie.

Guadeloupe: Found rather uncommonly in the second growth on hills, where we observed it only in the hills behind Goyave, at Boullante, and at Vieux-Bourg (Grande Terre).

Crotophaga ani Linnaeus

ANI

Merle Corbeau; L'Ami des Savanes

Guadeloupe: Of doubtful occurrence. A planter told Noble that it had been seen after hurricanes.

Les Saintes: Recorded by Mimi. On July 5, 1937 we found it perhaps the commonest bird on Terre-de-Haut, frequenting pastures and brushy land, but observed none on Terre-de-Bas. A pair was collected. One stomach contained 15 weevils, *Lachnopus curvipes,* and the other 6 *Lachnopus curvipes* and a grasshopper.

Speotyto guadeloupensis guadeloupensis Ridgway

MARIE GALANTE BURROWING OWL

Coucou

Guadeloupe: Although listed by many authors, there is no evidence that it ever existed there.

Marie Galante: Formerly found on the cliffs, now exterminated by the mongoose. I have examined four specimens in the Musée L'Herminier; a fifth was presented by them to the Museum of Comparative Zoölogy.

Nephoecetes niger niger (Gmelin)

ANTILLEAN BLACK SWIFT

Hirondelle de Montagne; Gros Martinet Noir

Guadeloupe: Winch collected 23 specimens in 1890, one of which (a female collected on August 11) is the type of Cory's *Nephoecetes niger guadeloupensis.* Noble found it abundant on the edges of the Grand Bois, and collected three at Goyave on September 1, 1914. In 1937 we found it common in the hills behind Goyave on June 21 and at Sainte Marie on June 24 and 25, and observed a few at Capesterre June 14, Matouba July 1, and Bonne Mere July 15.

Chaetura acuta (Gmelin)

LESSER ANTILLEAN SWIFT

Petit Martinet Noir; Hirondelle-Mouche

Guadeloupe: Ober observed the species but obtained no specimen. Winch obtained one, and Dr. Colardeau sent another to Lawrence, which became his type of *Chaetura dominicana colardeaui.* Noble obtained 11 at Goyave August 29 and 30, 1914. We found it common at Dolé on June 16, 1917, but observed none there on other days; and abundant in the hills behind Goyave on June 21. Lesser numbers were observed at Basse-terre, Morne Folie, the Soufrière Mountain, Matouba, Trois Rivieres, Sainte Marie, and Sainte Rose.

Orthorhynchus cristatus exilis (Gmelin)

GILT-CRESTED HUMMINGBIRD

Fou-Fou; Oiseau-Mouche Huppé

Guadeloupe: Common and generally distributed, observed from the coast to high elevations on the Soufrière. On July 2, 1937 a nest with 2 eggs was found 6 feet from the ground attached to a twig of a tree in the second growth forest. The nest was the usual structure of fine plant fibers plastered outside with lichens. The incubating female sat very closely.

Three adult males, two adult females, two immature specimens, and one of undetermined sex were collected at various localities in 1937. The contents of 6 of the 8 stomachs were examined, and found

to consist of small spiders 65 per cent, and insects 35 per cent (including minute Coleoptera 5 per cent and small winged ants 8.2 per cent).

Les Saintes: Common on both Terre-de-Bas and Terre-de-Haut on July 5, 1937. A female was collected on the former, and a male on the latter. Not previously recorded.

Désirade: Collected by Richardson in 1886. We found it common on July 9, 1937, and collected a pair. One stomach contained small black ants, and the other small spiders.

Marie Galante: The Field Museum has 9 specimens collected by Richardson in 1886. We found it common on July 18, 1937, and collected a pair at Trois Islets. One of the stomachs contained minute Coleoptera.

Sericotes holosericeus holosericeus (Linnaeus)

BLUE-BREASTED HUMMINGBIRD

Colibri Bleu; Oiseau-Mouche Bleu

Guadeloupe: In June and July, 1937 we found this species common at Dolé, Bananier, Goyave and Sainte Marie, and observed a few at Vieux-Bourg (Grande Terre). On December 29, 1930 six were observed at Ste. Claude. Four males and two females were collected in 1937. The six stomachs contained spiders 21.7 per cent; small brown winged ants 36.6 per cent; Coleoptera 23.3 per cent (including a small Chrysomelid, a small weevil, a small ladybird beetle, *Scymnillodes* sp., and many others); minute wasps 13.3 per cent; Diptera 1.7 per cent, and other insects 3.4 per cent.

Désirade: There are 2 specimens in the Field Museum collected by Richardson in 1886.

Marie Galante: The Field Museum has 3 specimens collected by Richardson in 1886. We saw three at Trois Islets on July 18, 1937.

Eulampis jugularis (Linnaeus)

GARNET-THROATED HUMMINGBIRD

Gros-Colibri. Oiseau Mouche a Gorge Rouge

Guadeloupe: Common in all wooded regions, although showing a preference for higher altitudes. However, at Sainte Marie it was abundant in lowland woods, and some were even seen in a wooded swamp close to the edge of the sea. A male and three females were collected. Their stomach contents consisted exclusively of insects, among which ants (mostly winged) formed 34 per cent; minute Bostrichid beetles 2.5 per cent: small Diptera 12.5 per cent; coffee

lantern flies, *Bothriocera venosa,* 15 per cent; and small Lepidopterous larvae 15 per cent.

Les Saintes: Recorded by Bond.

Désirade: Recorded by Bond.

Marie Galante: Recorded questionably by Bond; reason not stated.

Magaceryle alcyon alcyon (Linnaeus)

BELTED KINGFISHER

Pie de Mer

Guadeloupe: First listed by Ober. There is a male collected September 28, 1890 by Winch in the Field Museum.

Megaceryle torquata stictipennis (Lawrence)

RINGED KINGFISHER

Pie

Guadeloupe: This giant species has been recorded by various authors, and Noble found a nesthole in high sandbanks along the Rivière de Goyave in the spring of 1914, and obtained a specimen. The type was obtained by Dr. Colardeau in 1885. There are several specimens in the Musèe L'Herminier. It is found locally along wooded streams, but is extremely wary. We observed it upon four occasions in 1937. One flew high over the hotel at Dolé on June 15; one was seen along a wooded, lowland stream near Sainte Marie on June 24 and again the next day, when it was shot and injured but not recovered; and one was observed in the mountains west of Bonne Mere on July 15.

Melanerpes herminieri (Lesson)

GUADELOUPE WOODPECKER

Tapeur

Guadeloupe: This woodpecker, notable as being the only representative of its family in the Lesser Antilles, is not rare, but is very locally distributed, mostly in the low heavily wooded hills of the northeastern part of Guadeloupe proper. We saw it only once in the interior mountains (one in the mountains above Matouba on July 1). We found it most common at elevations of about 500 feet in wooded hills back of Sainte Marie, Goyave, Bonne Mere, and Sainte Rose, frequently mostly on dead trees. Its call note is a loud, harsh gu-r-r-r-r-rh, extremely different from that of *M. portoricensis.*

At times it beats tattoos on the wood. It is not at all shy, and appears all black in the field. A male and four females were collected. An adult male collected near Sainte Marie on June 30, 1937 had the iris dark brown; bill black; legs and feet bluish slate-gray; claws dusky; soles dull yellow. Four of the stomachs contained insects and their larvae 93 per cent (Cerambycid beetles 37.5 per cent; other Coleoptera 16.2 per cent; Muscid fly 2.5 per cent; small ants 0.7 per cent; miscellaneous insects 36.1 per cent, and a seed 7 per cent.

Tyrannus dominicensis vorax Vieillot

LARGE-BILLED KINGBIRD

Pipirit

Guadeloupe: Common in the lowlands, and occasionally observed at lower elevations in the mountains. Four females (one of them immature) were collected. The three adults measured: culmen from base 32.4–34 (33.2), and width at frontal antiae 15.9–16 (15.9) millimeters. They are clearly *vorax.* Ridgway records *dominicensis* from the Island, but it seems likely that his specimen was an intergrade, such as are often found in the northern Lesser Antilles. Four stomachs contained wasps 75 per cent (15 per cent of them *Polistes*); 3 weevils, *Diaprepes spengleri* (in one stomach), 10 per cent; small drupes 15 per cent.

Désirade: Common on July 9, 1937. The stomach of an immature specimen collected contained wasps (30 per cent) and grasshoppers (70 per cent). Not previously recorded.

Marie Galante: Common on July 18, 1937. A male collected at Trois Islets measured, culmen from base 34.9 and width at frontal antiae 15.5 millimeters. Its stomach contained a dragonfly (*Erythrodiplax umbiata*) 70 per cent, and Coleoptera, 30 per cent. Not previously known from the Island.

Myiarchus tyrannulus oberi Lawrence

OBER'S CRESTED FLYCATCHER

Pipirit Gros-Tête

Guadeloupe: Although Dr. Colardeau gave some information concerning this species (saying it was not rare in some parts of the mountains), the only positive record is of two birds seen and an immature male collected by Noble at Sainte Rose on July 11, 1914.

Blacicus brunneicapillus Lawrence

DOMINICAN PEWEE

Gobe-Mouche Brun

Guadeloupe: Winch obtained 4 specimens in 1890. Noble found it not rare but local, obtaining 1 specimen on the Soufrière and 8 at Sainte Rose. We encountered only four individuals during our stay, a male which was collected at Morne Folie on June 18, 1937, and three on the Soufrière on June 29, one of which, a female, was collected. The two stomachs contained exclusively insects, among which Coleoptera formed 52.5 per cent and Hymenoptera 35 per cent.

Elaenia martinica martinica (Linnaeus)

ANTILLEAN ELAENIA

Petit Pintade; Gobe-Mouche Huppé

Guadeloupe: Abundant and generally distributed, from the mountain forests to the seacoast. Six males and three females collected proved to be typical *martinica,* and I have given their measurements elsewhere (Journal of the Barbados Museum and Historical Society, vol. 5, 1938, pp. 124–125). The contents of five of the stomachs was examined, and found to consist of animal matter 10 per cent (a nymh opf *Phymata* sp., and a spider), and vegetable matter 90 per cent (fruits and seeds of *Solanum bahamensis* 30 per cent; other berries and fruits 60 per cent).

Les Saintes: Common on Terre-de Bas July 5, 1937 (when a female was collected), and observed on Terre-de-Haut. The stomach of the specimen collected contained a few fragments of fruits. Not previously recorded.

Désirade: There are 6 specimens in the Field Museum obtained by Richardson in 1886. We recorded 10 on July 9, 1937.

Marie Galante: Richardson obtained 5 specimens in 1886. We found it common at Trois Islets on July 18, 1937, and collected a female, the stomach of which was filled with small black drupes.

Hirundo erythrogaster Boddaert

BARN SWALLOW

Hirondelle

Guadeloupe: In the U. S. National Museum there is a specimen collected by Ober.

Progne dominicensis (Gmelin)

CARIBBEAN MARTIN

Hirondelle at Dominique

Guadeloupe: Apparently unknown from here until Noble's visit. In 1914 he found it not rare on the east coast of Guadeloupe proper and on Grande Terre, and obtained 6 specimens at Goyave August 30 and 31. We found it common, observing it at Basse-Terre, Bananier, Capesterre; and Port-Louis, Pointe-a-Pitre and Le Gosier, Grande Terre. A male was collected at Bananier on June 28, 1937, and two males and a female at Port-Louis on July 8, 1937. At the latter locality the birds frequented an extensive mangrove swamp with dead trees scattered through it. The first stomach was filled with comminuted insects, mainly Pentatomidae. The latter three contained Syrphie flies (*Volucella obesaq*, 35 per cent; wasps 24.7 per cent; Carabid beetles 8.3 per cent; Hydrophilid Beetles (*Tropisterna collaris*), 19 per cent; an all black species of *Tropisterna*, 7.3 per cent; bean fleabeetles (*Cerotoma ruficornis*), 2.7 per cent; a dragonfly, 12 per cent.

Les Saintes: On July 5, 1937 we found it breeding on the cliffs on both Terre-de-Bas and Terre-de--Haut. Not previously recorded.

Désirade: Two seen on the plateau, July 9, 1937. First record for the Island.

Marie Galante: A few were observed at Trois Islets on July 18, 1937. First record.

Troglodytes guadeloupensis (Cory)

GUADELOUPE WREN

Rossignol

Guadeloupe: Formerly common; now probably extinct. Last seen in 1914 by Noble in high woods that had been cut over near Sainte Rose. He obtained a female on July 13. The type locality is in Grande Terre.

Allenia fusca (Miller)

SCALY-BREASTED THRASHER

Grive Fine

Guadeloupe: Common on the wooded hills of Guadeloupe proper. One example was seen at Vieux-Bourg, Grande Terre on July 13, 1937. Adult males were collected near Goyave on July 21, Trois Rivieres June 22, and Sainte Marie June 24; a juvenile male at

the latter locality June 30, and a female at Sainte Rose July 12. One of the stomachs was empty; the other four contained berries and drupes, 54 per cent; seeds of Oleaceae 20 per cent; other seeds 1 per cent; a land snail 8 per cent, and 2 slugs 17 per cent.

Désirade: Richardson obtained one in 1886.

Marie Galante: Listed by Cory, although it is not included in the list of specimens obtained by Richardson, and there is no specimen from there in the Field Museum. We found it common at Saint Louis on July 18, 1937, and collected a male; we also observed one near the coast at Trois Islets. The stomach of the specimen collected contained drupes and berries.

Margarops fuscatus densirostris (Vieillot)

BARKER PEARLY-EYED THRASHER

Grosse Grive

Guadeloupe: This species is persecuted so much as a game bird that it has become very shy and wary. It is found in the rain forest, where we observed it commonly on Morne Folie and on the Soufrière.

Désirade: Richardson obtained 12 specimens in 1886. We found it common on the sides of the mountain on July 9, 1937, and collected two males. Their stomachs contained drupes, 56 per cent, and a long-horned grasshopper, (*Neoconocephalus*), 44 per cent.

Cinclocerthia ruficauda tremula (Lafresnaye)

GUADELOUPE TREMBLER

Trembleur; Grive Trembleuse

Guadeloupe: Found only in dense woods, both on the higher mountains and on the hills of lower elevation. One is almost sure to come across two or three during the course of a morning's field work in such regions. An adult male, 3 adult females, and 2 immature females were collected at Morne Folie, the Soufrière, Goyave, Sainte Rose, and the mountains west of Bonne Mere. Seven stomachs (including that of a specimen too damaged to save) contained exclusively fruits and seeds, with the exception of some Mantid fragments in one stomach amounting to 8 per cent of the total contents. Of the remaining 92 per cent, soft Araceous seeds formed 52 per cent; soft, fleshy berries 20 per cent; gelatinous-coated seeds 14 per cent, and other seeds 6 per cent.

A female collected at Morne Folie June 18, 1937 had the iris bright golden yellow; bill black; legs and feet yellowish brown, more or less tinged with gray above, including the claws; soles yellow.

An adult male measured, wing 104.3; tail 89; culmen from base 35.9; tarsus 30.5, Three adult females meausred, wing 98.6–101.4 (99. 8); tail 83.3–88 (85.9); culmen from base 40.5–42.5 (41.3); tarsus 30–32 (31.3) millimeters.

These specimens are much like specimens of *C. r. tenebrosa* in color, but are very slightly darker on the upper surface, particularly upon the wings, and slightly more rufescent below.

There are 2 specimens from Grande Terre in the Field Museum collected by Richardson in 1886, but it is doubtful if the species occurs there at present.

Cichlherminia lherminieri lherminieri (Lafresnaye)

GUADELOUPE FOREST THRUSH

Grive a Pieds Jaunes

Guadeloupe: Formerly common, and an important game bird, but due to its ground-frequenting habits it fell an easy prey to the mongoose. However, Noble thought it was adapting itself by abandoning its terrestrial habits and possibly becoming somewhat more common in 1914, when he obtained 24 specimens from near Sainte Rose and Goyave. Nevertheless, in 1929 Breta reported it to Bangs as extinct or nearly so. In 1937 we observed a few on the lower parts of the Soufrière on June 29, and found the species in limited numbers in rather low hardwood forests near Sainte Marie, Goyave, and west of Bonne Mere, a total of somewhat over twenty birds being observed during the course of our visit, so it is evident that, while not common, it is far from extinct.

On June 30 in a rather low hardwood forest in a stream valley in foothills near Sainte Marie a family consisting of the parent birds and three young just out of the nest was encountered. Two of the young were able to fly slightly, the thirds not at all. When the latter was captured alive its cried brought the parents around. They generally kept a safe distance away, flitting nervously from tree to tree, keeping from 5 t 20 feet above the ground, and uttering soft *tuck, tuck* alarm notes, and quite a variety of scold notes. Occasionally t hey dashed much closer uttering lound complaining screeches. The male was always the boldest, so it was collected, but the female was much more cautious and always kept more in the

background, so it proved impossible to collect it. Directly above the spot where the young unable to fly was found was an empty nest from which it appeared probable it had fallen. It was in a tree at a height of 35 feet above the ground, at the point where some small leaves shaped somewhat like those of the banana plant but shorter and stouter, sprouted directly from the trunk, which was bare up to this point, and was secured to the bases of those leaves. Externally it was constructed almost entirely of gray mosses loosely woven together.

Two of the young as well as the male parent were preserved as specimens. The adult male had the iris hazel; bare orbital ring golden yellow; upper mandible dusky, more or less tinged with yellow; legs and feet golden yellow, claws slightly tinged with dusky. One of the juveniles (a male, unable to fly) had the iris hazel; bare orbital ring dusky brown; upper mandible dusky brown, slightly tipped with horn color; fleshy base of both mandibles dull white; lower mandible horn color more or less tinged with dusky; inside of mouth dull orange yellow; legs and feet pearly gray more or less tinged with straw color; back of legs and soles straw color.

Another adult male was collected in the mountains west of Bonne Mere on July 15, 1937. The measurements of the two adult males are given in my paper on the birds of Montserrat elsewhere in this same Journal.

All specimens that we observed were in trees never closer than four feet to the ground.

The intestines of the juvenile bird which could fly slightly contained a large tapeworm, which I have preserved for possible future identificación. The stomach of this individual contained fruit (90 per cent), and bones of a small lizard (10 per cent). The stomach of the other juvenile was nearly empty, containing only the mandibles of what had evidently been a strong-jawed coleopterous larva. The stomach of the male parent was very large and was crammed with 14 dark-colored drupes 8-9 millimeters in diameter. The other male had eaten three large drupes.

Vireo calidris barbadensis (Ridgway)

BARBADOS VIREO

Siffleur; Piade

Guadeloupe: A well known summer resident and breeder, but it is doubtful if it occurs in the winter. The latest definite records I can find are of specimens taken by Ober in September. It is fairly

common in wooded regions, both in the high mountain forest and in the foothills. The following specimens were collected in 1937: Adult male, Dolé, June 16; inmature, Trois Rivieres, June 22; adult male, Vieux-Bourg, Grande Terre, July 13; adult male and adult female, Le Moule, Grande Terre, July 16. The five stomachs contained 33 per cent of insects (Hemiptera, a click-beetle of the genus *Monocrepidus,* weevils and other Coleoptera), and 67 per cent of small fruits (drupes, berries, and the soft seeds of *Araceae*).

Les Saintes: On July 5, 1937 it was common on Terre-de-Bas (where a male? was collected), and it was observed on Terre-de-Haut. The stomach of the specimen collected contained drupes. Not previously recorded.

Désirade: On July 9, 1937 two fighting birds (one definitely a male, the other probably so) were collected at one shot; no others were seen or heard. The stomachs contained drupes and berries 97.5 per cent, and Coleoptera 2.5 per cent. First record for the island.

Marie Galante: There are two specimens in the Field Museum collected by Richardson in 1886. We found it common on July 18, 1937, and collected a male at Trois Islets. Its stomach contained drupes 70 per cent and insects 30 per cent (fleabeetles 15 per cent).

Coereba bartholemica (Sparrmann)

ST. BARTS HONEY CREEPER

Sucrier

Guadeloupe: Common practically everywhere; probably the most abundant and universally distributed bird on the island. Three adult males, two adult females, and three immature specimens were collected at Dolé, Fond Cabe, Sainte Marie, Bananier, Malendure, and Le Moule (Grande Terre). These specimens differ in nowise from specimens from islands to the north, so I regard them as *bartholemica.* Three adult males measure: Wing 60.8–63.2 (62); tail 39–41.4 (40); culmen from base 16–17.5 (16.9); tarsus 18.1–18.7 (18.4), and two adult females, wing 53.5–58 (55.75); tail 35.3–37.4 (36.35); culmen from base 16–16.6 (16.3); tarsus 16.6–17.9 (17.25) millimeters. One of the males has the frontal region partly white.

Stomachs of five of the specimens contained spiders 17 per cent, and insects and their larvae and eggs 83 per cent, including lepidopterous larvae 16 per cent, small Coleoptera 14 per cent, Diptera 4 per cent, and ants 4 per cent.

Les Saintes: First recorded by Bond. Common on Terre-de-Bas July 5, 1937, where an adult male was collected, but curiously none were observed on Terre-de-Haut. The specimen collected measured, wing 61.7, tail 39, culmen from base 16.7, and tarsus 18.6 millimeters. Its stomach contained 2 lepidopterous larvae and some fragments of Coleoptera, plus a few grains of sand.

Désirade: Richardson obtained two in 1886. We observed a few near the coast on July 9, 1937.

Marie Galante: Richardson collected six in 1886. In 1937 we found it common at Trois Islets and collected an adult male on July 18. It measured, wing 63.2, tail 41.8, culmen from base 16.2, tarsus 19.2 millimeters. Its stomach contained small lepidopterous larvae, and fragments of eggshell.

Mniotilta varia (Linnaeus)

BLACK AND WHITE WARBLER

Demi-Deuil

Guadeloupe: Dr. Colardeau reported it as rather common from the end of October to the beginning of May.

Compsothlypis americana pusilla (Wilson)

NORTHERN PARULA WARBLER

Guadeloupe: Dr. Colardeau reported it as not plentiful, from December to March.

Dendroica tigrina (Gmelin)

CAPE MAY WARBLER

Guadeloupe: Dr. Colardeau sent three specimens to the U. S. National Museum, one of them obtained in his yard in Basse-terre. He usually found them in coffee shade trees in the mountains, reporting it from November to April.

Dendroica petechia ruficapilla (Gmelin)

GUADELOUPE GOLDEN WARBLER

Oiseau Jaune; Petit Jaune

Guadeloupe: Very common in the lowlands, in clearings, scrub country, and mangrove swamps, but never seen in the woods. Observed as high as Ste. Claude in clearings. One adult male, six

females, and one juvenile specimen were collected at Dolé, Trois Rivieres, Bananier, Sainte Marie, Vieux-Bourg (Grande Terre), and Le Moule (Grande Terre).

The adult male measures, wing 59.2, tail 43.7, culmen from base 14, tarsus 19.4 millimeters, and the 6 females, wing 54.3–55.5 (54.8); tail (in five) 42.6–44.2 (43.4); culmen from base 13.1–14.6 (14.1); tarsus 18.2–19.6 (18.8) millimeters.

Eight stomachs contained vegetable matter 5.4 per cent (small seeds in two stomachs), and animal matter 94.6 per cent (spiders 6.2 per cent; ticks 2 per cent; insects and their larvae 86.4 per cent, including Orthoptera, Hemiptera, fleabeetles, weevils and other Coleoptera; small winged ants, and other Hymenoptera).

Les Saintes: Recorded by Bond. We found it common on both Terre-de-Bas and Terre-de-Haut on July 5, 1937, and collected an adult male on the former. It measured, wing 58.3, tail 44.1, culmen from base 14.6, and tarsus 18.7 millimeters. It had eaten an aphid, some beetles, and some unidentified insects.

Désirade: First recorded by Bond, who found it rather rare. On July 9, 1937 we found it common near the coast, and observed a few on the plateau and on the sides of the mountain. An adult male was collected, which measured, wing 56.7, tail 42.7, culmen from base 14.6, and tarsus 20.2 millimeters. It had eaten a small weevil, other Coleoptera, and some other insects.

Marie Galante: Richardson collected 4 specimens in 1886. On July 17 and 18, 1937 we found it abundant, recording it at Grand Bourg, Trois Islets and Saint Louis. An adult male collected at Trois Islets on July 18 measured, wing 56.6, tail 42.6, culmen from base 14.6, and tarsus 19 millimeters. Its stomach contained 95 per cent of fleabeetles, and 5 per cent of miscellaneous insects.

Dendroica plumbea guadeloupensis Brodkorb

GUADELOUPE PLUMBEOUS WARBLER

Fauvette Gris; Petite Pintade

Guadeloupe: This bird is fairly common wherever deep woods are found, both in the high mountain forests and in the foothills. In travelling through the great lonely woods, where all birds are chiefly conspicuous by their scarcity (often one may travel for half an hour without observing a single bird), the first bird one is likely to encounter is this. Most of what birds there are in these great woods seem to congregate in particular "cases", as likely as not in

some pocket by a stream valley, where a fairly large congregation of individuals representing several species may be found. But far away from these "oases", in fact at almost any point, the monotony and gloom of the uncannily silent forest may be suddenly and unexpectedly broken by coming across either a single bird or a small family group of these warblers. For this reason they became particular favorites of ours.

Its song is weak and inconspicuous, consisting of three syllables. The call note is an equally inconspicuous *tcheck,* but at times it utters loud, rattling scold notes, somewhat similar to those of some wrens. As it works through the brush its long tail is made even more noticeable by the frequency with which it twitches it.

Fourteen specimens (6 adult males, 1 immature male, 2 immature females, and 5 unsexed immature and juvenile specimens) were collected on the Soufrière and Morne Folie, and in woods near Matouba, Trois Rivieres, Goyave, Bananier, Sainte Marie, Bonne Mere and Sainte Rose. An adult male collected June 18, 1937 on Morne Folie had the iris dark brown; upper mandible dusky, lower horn color slightly tinged with dusky at the tip; legs and feet brownish straw color; soles yellow; claws yellowish brown.

The fourteen stomachs contained spiders 9.6 per cent; a small lizard 0.7 per cent; Fulgoridae 5 per cent; other Homoptera 4.3 per cent; large Staphylinid beetles 2.9 per cent; weevils 8.4 per cent; other Coleoptera 10 per cent; Lepidopterous larvae 5.7 per cent; miscellaneous comminuted insects 53.4 per cent.

Dendroica plumbea plumbea Lawrence

DOMINICA PLUMBEOUS WARBLER

Fauvette Gris

Marie Galante: Richardson obtained 8 specimens in 1886, which are stated by Brodkorb to represent the Dominican race. There is no country on Marie Galante now which would seem to be suitable for this bird, and I doubt very much if it still exists there.

Dendroica breviunguis (Spix)

BLACK-POLL WARBLER

Guadeloupe: Dr. Colardeau observed great numbers for eight or ten days in October, 1882, and obtained a specimen in the Botanic Gardens at Basse-terre on October 10. In 1883 he was unable to find any.

Dendroica virens virens (Gmelin)

BLACK-THROATED GREEN WARBLER

Guadeloupe: Dr. Colardeau reported it as rather common from November to March in coffee plantations.

Seiurus aurocapillus (Linnaeus)

OVEN-BIRD

Guadeloupe: Recorded by Bond.
Les Saintes: Recorded by Bond.

Seiurus noveboracensis noveboracensis (Gmelin)

NORTHERN WATER-TRUSH

Guadeloupe: Ober obtained a female in mangroves bordering the Rivière Salée near Pointe-á Pitre. The Field Museum has 2 males from Guadeloupe, collected by Winch on September 18 and 28, 1890.

Wilsonia canadensis (Linnaeus)

CANADIAN WARBLER

Guadeloupe: Reported by Dr. Colardeau.

Setophaga ruticilla (Linnaeus)

AMERICAN REDSTART

Petit Dufeu

Guadeloupe: Ober obtained an adult male, an immature male, and a female in September. These and three specimens obtained by Guesde are in the U. S. National Museum. The Field Museum has 2 specimens from Guadeloupe.

Marie Galante: Richardson obtained two in 1886.

Holoquiscalus lugubris guadeloupensis (Lawrence)

GUADELOUPE GRACKLE

Merle; Bout de Petun

Guadeloupe: On Guadeloupe proper we found it decidedly rare except on the westcoast from Vieux Habitants to Malendure, and in the northeastern region around La Boucan, Lamentin and Bonne Mere, where it was common. Elsewhere a very few were seen at

Basse-terre, Goyave, Capesterre, and Petit Bourg. On Grand Terre it was much more common and generally distributed.

Seven adult males, three females, and one immature male were collected at Goyave, Malendure, La Boucan, Port-Louis (Grande Terre), Vieux-Bourg (Grande Terre) and Le Moule (Grande Terre).

Eleven stomachs contained *Anolis* lizards 42 per cent; land snails (mainly *Helicina fascita*) 41.5 per cent; cane weevils, *Diaprepes spengleri,* (20 in one stomach, and about an equal number in another), 12.8 per cent; rotten sugar cane borer weevils, *Metamasius hemipterus* (large number of individuals) 7.8 per cent; unidentified weevils 7.8 per cent; other Coleoptera 14 per cent; Locustid eggs 1.8 Basse-terre, Goyave, Capesterre, and Petit Bourg. On Grand Terre 7.4 per cent; other fruits 7.4 per cent; roots 3.3 per cent.

Marie Galante: Richardson obtained specimens in 1886. On July 17, 1937 we watched the birds congregating to roost in trees at the edge of the town of Grand Bourg in the evening. The next day we found the species common at Trois Islets, and collected a male.

Tanagra flavifrons flavifrons (Sparrmann)

GREEN EUPHONIA

Perrouche; Perrique de Matouba

Guadeloupe: Known only from high mountain forests. We found it only on the Soufrière, where it was rather common on June 29, 1937, and we collected a pair. The male had the iris dark grayish brown; upper mandible black; lower mandible grayish blue tipped with black; legs and feet slate gray, claws dusky, soles dull yellow. Both had eaten the customary mistletoe berries.

Saltator albicollis guadeloupensis Lafresnaye

GUADELOUPE SALTATOR

Gros-Bec

Guadeloupe: We found it mostly in second growth thickets, where it could hardly be called rare. Regions in which it was observed were Dolé (female collected June 17, 1937); hills behind Goyave (male collected July 2); Sainte Marie (2 females collected June 24 and June 30); Sainte Rose, and Vieux-Bourg, Grande Terre (unsexed bird collected July 13). On June 24, 1937 near Sainte Marie a nest was found 20 feet from the ground in a densely foliaged tree. It was a cup-shaped, loosely constructed affair of roots and small twigs,

and contained young nearly ready to leave the nest. All five stomachs contained both large weevils and fruits, a total of 26 per cent of weevils and 74 per cent of fruits (among which Solanaceous fruits formed 16 per cent).

Tiaris bicolor omissa Jardine

CARIB GRASSQUIT

Mangeur d'herbes; Cici-zèbe

Guadeloupe: Common everywhere in open and brushy country in the lowlands; not found in the deep woods. Four adult males, one adult female, and two immature males were collected at Dolé, Fond Cabe, Bananier, La Boucan, and Port-Louis (Grande Terre). The seven stomachs contained small seeds, plus sand for grinding purposes.

Les Saintes: Common on Terre-de-Bas, and observed on Terre-de-Haut. An adult male was collected on the former and a semi-adult male on the latter on July 5, 1937. Both stomachs contained small seeds and sand. Not previously recorded.

Désirade: Collected by Richardson in 1886. On July 9, 1937 we found it common both in the lowlands and on the plateau, and collected an adult male, the stomach of which contained small seeds and sand.

Marie Galante: Collected by Richardson in 1886. We found it common, and collected an adult male at Trois Islets on July 18, 1937. Its stomach contained the usual seeds and sand.

Loxigilla noctis dominicana (Ridgway)

DOMINICAN BULLFINCH

Père Noir (male); Gross-Bec (female).

Guadeloupe: Common and generally distributed, from the high mountain forests to the coastal swamps. This and the honey creeper are unquestionably the two commonest and most widely distributed birds on the island. Twelve specimens were collected, consisting of 5 adult males, 6 females, and 1 immature male, obtained on the Soufrière, and at Dolé, Trois Rivieres, Bananier, hills behind Goyave, and Vieux-Bourg (Grande Terre).

The twelve stomachs contained weevils 30.8 per cent, fruits 54.6 per cent, seeds 14.6 per cent, and many stomachs contained sand in addition.

Les Saintes: Common on Terre-de-Bas, but not found on Terre-de-Haut. A pair was collected on the former island on July 5, 1937. The male measures, wing 72.5, tail 51.3, culmen from base 17.2, and tarsus 20.5 millimeters, and the female, wing 64.8, tail 54.4, and tarsus 19.6 millimeters. One stomach contained berries and sand. Not previously recorded.

Marie Galante: Obtained by Richardson in 1886. On July 18, 1937 we observed two at Trois Islets, and found it fairly common in higher country back of Saint Louis, where we collected two adult males. These measure, wing 72.3–72.7 (72.5); tail 51.7–51.8 (51.75); culmen from base 15–16.7 (15.85); tarsus 20.3–21.2 (20.75) millimeters. Their stomachs contained weevils 32.5 per cent and seeds 67.5 per cent.

Loxigilla noctis desiradensis Danforth

DÉSIRADE BULLFINCH

Père Noir; Gros-Bec

Désirade: Richardson collected three males on March 7, 8 and 11, 1886, and two females on March 11 and 13, 1886, and Bond a female on January 20, 1930. With all this material available for study, I described this form with one of Richardson's males in the Field Museum as the type (Journ Agr. Univ. P. R., 21, 1937, p. 229) before our visit to Désirade We had hoped to obtain a fair series there, but on the day of our visit (July 9, 1937), despite much diligent search, we were able to locate but one bird. That was an adult male, which was promptly collected, on the side of the mountain. Its iris was very dark brown; upper mandible black, lower dark horn color, more or less tinged with dusky in parts, and the posterior lateral parts were black; legs and feet slate gray, claws dusky, soles tinged with dull yellow. It measured, wing 68, tail 51.6, culmen from base 15.3, and tarsus 20 millimeters, thus agreeing well in size with other examples of this form. Its stomach contained small seeds and sand.

THE BIRDS OF MONSERRAT

By Stuart T. Danforh

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Monserrat is one of the islands of the British Leeward Islands colony. It is 25 miles southwest of Antigua, 35 miles southeast of Nevis, and about the same distance northwest of Guadeloupe. It lies in latitude 16° 45′ N., and longitude 61° W., and is about 11 miles long by 7 miles wide, with an area of 32 square miles. It is in the form of an oval tapering towards the north, and is a rugged, mountainous island of volcanic formation.

There are two principal groups of mountains, the Soufriere system in the southern part of the island, and the Centre Hills in the central and north central part. The former group includes Gage's Mountain, Chance's Mountain, the Soufriere Peak, Cassel's Peak, South Soufriere, and other peaks. At least some of these mountains are actively volcanic, possessing a number of craters emitting hydrogen sulphide and other noxious gases, sulphur, steam, and boiling water discolored by compounds of volcanic origin which it holds in solution. Within the past decade these were the scene of more violent activity, producing a series of earthquakes and other phenomena which alarmed the populace and did considerable damage. The highest peak in this system (Soufriere Peak) attains an altitude of 3,002 feet.

The Centre Hills are somewhat lower (the highest point being a peak of only 2,450 feet) and they are not actively volcanic.

The upper parts of both mountain groups are clothed with virgin rain forest, which does not usually extend below an elevation of from 1,500 to 2,000 feet. However, at the estate known as Woodlands (on the north central part of the leeward coast) this mountain fores reaches down from the Centre Hills to the surprisingly low elevation of 800 feet above sea level. Here such typically mountain birds as the oriole and trembling thrush may be observed with slight effort by merely taking a short walk from the highway. If this fascinating and easily accessible forest could be preserved for posterity it could easily become one of the great natural attractions of this beautiful little island, already blessed with an assortment of them far out of proportion to its size.

Montserrat possesses no extensive mangrove swamps, due to the abruptness of its coastline, which in many places is composed of cliffs, forming nesting places for tropical birds. There are no fresh water ponds or lakes, and the only brackish water pond large enough to merit the name is that near Elberton, usually known as Fox's Bay Pond, on the leeward coast a few miles to the north of Plymouth. It covers an area of perhaps ten acres, and is for the most part very shallow with such a large number of mangroves growing in it that from a distance it appears more like a woodlot than a pond. However, in the center there is a small-area of open water somewhat less than an acre in extent, invisible until one reaches it. Here pied-billed grebes, coots, gallinules, and possibly other water birds nest.

At lower elevations near the sea there are some dry, brush covered hillsides where many varieties of birds may be found, and some densely wooded ravines or guts are always points of attraction for the ornithologist.

Some information which has come to hand concerning the island of Redonda is also included in this paper. Redonda is a small uninhabitated rocky island situated north of Montserrat approximately half way between that island and Nevis. It consists chiefly of a plateau surrounded by rocky precipices descending abruptly to the sea, making the plateau very difficult of access. Large numbers of seabirds nest there practically unmolested due to the isolation and inaccessibility of the island.

The first person to make collections of Montserrat birds of whom we have any record was J. E. Sturge of Plymouth, who in 1879 prepared and sent 17 species of birds to the British Museum. These were reported upon by P. L. Sclater (Proceedings of the Zoölogical Society of London, 1879, pp. 764–765).

Fred A. Ober, collecting for the Smithsonian Institution, visited the island on his second West Indian expedition in the latter part of 1880. Among the specimens he obtained were 7 examples of *Icterus oberi*, including the type, the description of which was published by G. N. Lawrence (Proceedings of the U. S. National Museum, 3, 1881, p. 351), but no complete report on his Montserrat collections was ever published. However, references to a number of specimens collected by him are made by Ridgway (U. S. National Museum Bulletin 50, 190—1919). Most of these birds are now in the Field Museum of Natural History.

T. Grisdale spent the month of February 1881 in Montserrat, living at an altitude of 1,200 feet at the edge of the virgin forest.

He confined his work almost entirely to the mountains, and collected 14 species, 7 of which had not been obtained by Sturge. He published a report of his collections and observations in the Ibis (1882, pp. 485–493).

Michael J. Nicoll, cruising in the West Indies on the "Valhalla", R.Y.S., spent the day of February 11. 1904 on Monserrat, and collected 10 species, including three species of migrant warblers not previously know from the island. He published a report on the birds collceted on this cruise in the Ibis (October, 1904, pp. 555–591).

T. Savage English, of England, who had previously resided in Grand Cayman, took up his residence in Montserrat in 1919, and has lived there continuously ever since. He has made numerous observations on the natural history of the island, and has published an account of the nesting of *Orthorhynchus cristatus exilis* in Montserrat (Ibis, January, 1928, pp. 13–16).

James Bond, of the Academy of Natural Sciences of Phidalphia, made collections on Montserrat during the latter part of December, 1929. No complete report on his work on the island has been published, although he makes many references to Monserrat birds in his "Birds of the West Indies", (1936).

The present author made fours short *in transit* visits to the island on July 22, 1922 (when he ascended to one of the craters on the Soufriere Mountain), July 31, 1931, June 30, 1935 (when a few nests and eggs were collected), and on August 13, 1935. Ornithological observations were made on all of these brief visits. In 1937, in the course of a rather extended ornithological expedition to the Lesser Antilles, accompanied by Gustavo Biaggi as assistant, he spent the period from February 6 to February 20 ,on the island. During this period about 70 specimens were collected, representing the majority of the resident species and a few that are migratory Since then our collections have been supplemented by specimens sent by Reginald A. Tonge of Plymouth, filling in weak spots in our collections, and greatly enhancing the value of the whole.

Prior to our visit there were published records of 44 species known from the island, excluding two which should be regarded as doubtful. In this paper fourteen species are recorded from the island for the first time, bringing the known avifauna of the island to 58 species definitely known to occur there.

In conclusion, it is a pleasure to mention our gratitude to various people in Montserrat who assisten in our work. First we must mention His Honour, T. E. P. Baynes, O. B. E., Commissioner of Montserrat, for his courteous and gracious assistance in granting us

permission for collecting and placing other government facilities for work at our disposal.

Mr. T. Savage English, the naturalist who has resided in Montserrat for many years, provided us with information which proved invaluable in our work, and the keen and benevolent interest which he took in our endeavours at all times was a pleasure to experience.

Mr. Swithin A. Schouten, Acting Curator of the Montserrat Botanical Gardens, was of much assistance to us both in official and friendly capacities, helping us to plan our work on the island, making arrangements for transportation and guides, and in other ways.

An annotated list of the birds known from the island follows.

Podilymbus podiceps antillarum Bangs

ANTILLEAN PIED-BILLED GREBE

Diver

R. A. Tonge has sent me an adult male collected on Fox's Bay Pond on February 26, 1938 (the wing of which measures 125.4 millimeters), and another collected May 4, 1938; also he states were taken at the nest at the same locality on September 1, 1937. The only previous record I find is of a specimen in the British Museum collected by Sturge in 1879.

Puffinus lherminieri lherminieri Lesson

AUDUBON'S SHEARWATER

There is a specimen in the British Museum collected by Sturge in 1879. I observed one at sea near Redonda on June 17, 1931.

Phaëthon aethereus mesonauta Peters

RED-BILLED TROPIC BIRD

Trofic

Apparently not previously known from the island. In February 1937 the species was observed commonly along the western coast of the island, breeding wherever there were suitable cliffs from Fox's Bay northward. R. A. Tonge has sent me an adult male and a specimen with the sexing lost taken at Garibaldi Hill on March 20, 1937, and a pair of adults collected at Rendezvous on February 7, 1938.

[*Phaëton lepturus catesbyi* Brandt

YELLOW-BILLED TROPIC BIRD

Bond (Birds of the West Indies, p. 8) states that he observed this species at Montserrat, but in view of the fact that he obtained no specimens, and that the common breeding bird of the island is unquestionably the red-billed species, I regard this record as unsatisfactory.]

Pelecanus occidentalis occidentalis Linnaeus

WEST INDIAN BROWN PELICAN

Observed along the coast near Plymouth and Fox's Bay in February, 1937. Not previously recorded from the island.

Sula leucogaster leucogaster Boddaert

BROWN BOOBY

Not yet recorded from Montserrat. On July 18, 1938 Messrs. H. E. Box, Hay Bryson, and A. Moore, of Antigua, visited Redonda, and found thousands of boobies breeding on the plateau. Some had eggs and others young at that time. They report that the nests were so thick and the birds so tame that it was difficult not to walk on them.

Fregata magnificens rothschildi Mathews

MAN-O-WAR BIRD

Frigate

Three observed at Plymouth on July 31, 1931, and one along the northwest coast on February 6, 1937, constitute the first records for the island.

Ardea herodias adoxa Oberholser

WEST INDIAN GREAT BLUE HERON

Sturge sent a juvenile specimen to the British Museum many years ago. R. A. Tonge has sent me an adult male collected at Cars Bay, in the north of the island, on December 16, 1937, and an adult female taken at the same place on January 18, 1938.

The status of the race or races of this heron inhabiting the West Indies is a matter of doubt. The rather scanty evidence available seems to indicate the existence of a resident race *adoxa*, supplemented by migrants of *herodias* from North America in winter. More data is needed to clear up this point. In the meanwhile these specimens

are listed provisionally as *adoxa*. The male measures, wing 489; tail 176.4; culmen from base 158; tarsus 179.6, and the female wing 429.2; tail 166.3, culmen from base 140.3 and tarsus 159 millimeters.

Egretta thula thula (Molina)

SNOWY EGRET

The only record is of a specimen sent by Sturge to the British Museum.

Florida caerulea caerulescens (Latham)

LITTLE BLUE HERON

Apparently very scarce. One in immature plumage was seen at Fox's Bay Pond February 11th and 12th, 1937, and R. A. Tonge sent an adult female taken at Isles Bay, April 7, 1938. Not previously recorded from the island.

Butorides virescens maculatus (Boddaert)

WEST INDIAN GREEN HERON

Water Witch

Common and generally distributed, being often found far from water and even high in the mountains, where I have seen it on Cassel's Peak at elevations of over 2,500 feet, and on Olveston Mountain it was common up to 1,500 feet in clearings and banana plantations. At lower elevations it frequents dry fields and pastures as well as the vicinity of water. Females were collected by a sulphurated water stream just below a crater on the Soufriere Mountain on February 9, and at a small damp spot in the uplands near Plymouth on February 8. The stomach of the former was nearly empty, containing merely a few insect remains; that of the latter contained 120 bluebottle flies (*Pyrellia ochricornis*), a large moth, a grasshopper and 3 *Anolis lizards*. Since then R. A. Tonge has sent me a pair collected at Fox's Bay Pond on January 20, 1938.

These specimens are all typical of *maculatus*, both in size and color. In fact, the male exhibits the smallest measurements of all the West Indian examples in my collection. The measurements of these specimens are as follows: 1 adult male, wing 155.3; tail 53.2; exposed culmen 59.3; tarsus 47.5. 3 adult females, wing 162.3–170.7 (165.9); tail 58.2–64.1 (60.6); exposed culmen 53.4–58.2 (55.6); tarsus 46–46.8 (46.8 (46.3) millimeters.

Nyctanassa violacea violacea (Linnaeus)

YELLOW-CROWNED NIGHT HERON

Crab Gaulding

Four were observed at Fox's Bay Pond on February 12, 1937. Since then R. A. Tonge has sent me an immature female collected at Cars Bay on September 20, 1937, and an adult male obtained at the same place on January 6, 1938. Not previously recorded from the island.

Querquedula discors (Linnaeus)

BLUE-WINGED TEAL

Pan Duck

I have a male collected by R. A. Tonge at Fox's Bay Pond on September 18, 1937, constituting the first record for the island.

Buteo jamaicensis jamaicensis (Gmelin)

WEST INDIAN RED-TAILED HAWK

Chicken Hawk

A hawk, almost certainly of this race, was heard calling at an altitude of 2,000 feet on Olveston Mountain, in the Centre Hills, on February 11, 1937, but the dense forest growth made it impossible to see or collect the bird. Bond has listed the species doubtfully from Montserrat, and residents report chicken hawks as bein seen on rare occasions.

Falco peregrinus anatum Bonaparte

DUCK HAWK

An example of this large migratory falcon was observed at Plymouth on February 8, 1937, and I have in my collection a male collected at Cork Hill, on January 4, 1938 and a female taken at Gingoes the same day, both collected by R. A. Tonge. Previously unrecorded from Montserrat.

Falco sparverius caribaearum Gmelin

ANTILLEAN SPARROW HAWK

Killi-killi

Common and generally distributed, most common in the lowlands, but found even in mountain forest, as on Olveston Mountain. A

pais was collected near Plymouth on February 10, 1937, and a female the next day on Olveston Mountain. One stomach contained a large centipede, a second crickets (*Gryllus* sp.), and the third crickets and a ground lizard (*Ameiva pluvianotata*).

Porzana carolina (Linnaeus)

SORA RAIL

Recorded by Bond.

Gallinula chloropus portoricensis Danforth

ANTILLEAN GALLINULE

Coot

Ten were observed at Fox's Bay Pond on February 12, 1937, and R. A. Tonge sent me a male obtained at the same place on January 12, 1938.

Fulica caribaea Ridgway

CARIBBEAN COOT

Coot

R. A. Tonge has sent me 9 specimens of various ages from Montserrat. A female was collected November 4, 1937 at Old Road Pond, whereas the other 8 specimens are all from Fox's Bay Pound, as follows: Adult male, Sep. 26, 1937; immature, Dec. 11, 1937; female juvenile, Dec. 18, 1937; immature, winter 1937–8; immature, Jan. 1, 1938; immature, Jan. 5, 1938; adult male, Jan. 14, 1938; immature female, Jan. 25, 1938. Recorded previously by Bond.

Totanus flavipes (Gmelin)

LESSER YELLOWLEGS

R. A. Tonge has forwarded two females taken at Oldroad Bay on July 30, and a male shot at Hotwater Pond on August 1, 1938. First records for the island

Actitis macularia (Linnaeus)

SPOTTED SANDPIPER

Common migrant and winter visitor. Twenty were noted near Plymouth on July 31, 1931. Three were seen and a male collected near Plymouth on February 10, 1937, and one was observed at Fox's

Bay Pound February 12, 1937. The stomach of the bird collected contained a large black wasp, some beetles, and a few other insects; also a little sand.

Arenaria interpres morinella (Linnaeus)

RUDDY TURNSTONE

R. A. Tonge has sent me females collected at Hot Water Pond May 5 and 16, 1938, and a male obtained at Kinsale Bay May 15, 1938. Not previously known from the Island.

Ereunetes pusillus (Linnaeus)

SEMIPALMATED SANDPIPER

R. A. Tonge has sent me two females obtained at Elbertson Pond on August 4, 1938. Not previously recorded from Montserrat.

Himantopus mexicanus (Müller)

BLACK-NECKED STILT

A specimen marked male but probably female obtained at Hot Water Pond on May 3, 1938 by R. A. Tonge constitutes the first record for the island.

Larus atricilla Linnaeus

LAUGHING GULL

Strangely enough, there are no Montserrat records for this wide-ranging bird, but I have in my collection a male in summer plumage obtained on the nearby Island of Redonda on March 11, 1938 by R. A. Tonge. It was not previously been recorded from Redonda.

Sterna hirundo hirundo Linnaeus

COMMON TERN

Five were seen at Plymouth on July 31, 1931, constituting the first record for the island.

Thalasseus maximus maximus (Boddaert)

ROYAL TERN

A female was obtained by R. A. Tonge at Oganows on May 1, 1938, and a male the following day. Not previously recorded from

Montserrat. The same collector also sent me a male obtained on Redonda March 11, 1938, constituting the first record of the species for that island.

Anoüs stolidus stolidus (Linnaeus)

NODDY TERN

Grisdale obtained a specimen from Montserrat, and believed it to be common on the coasts. Apparently there are no other records. Mr. H. E. Box and party reported thousands nesting on the precipitous cliffs on the windward side of Redonda on July 18, 1938,

[*Columba leucocephala* Linnaeus

WHITE-CROWNED PIGEON

Although this pigeon probably occurs rarely, there is no very satisfactory Montserrat record. Ridgway (U.S.N.M. Bull. 50, VII, 1916, p. 311) includes Montserrat in its range, but lists no specimen nor literature citation from there. Possibly his basis for its inclusion was a statement by Ober (Proc. U.S.N.M., I, 1878, p. 237) that he believed Antigua to be the southern limit of the breeding range of this species "except perhaps Montserrat". Until more definite information is available, I am listing the species hypothetically.]

Columba squamosa Bonnaterre

SCALED PIGEON

Pigeon

Said to be very common during the summer months, but we observed only five at St. George's Hill on February 15, 1937, and a pair at Tar River (on the windward coast) on February 16, the male of which was collected. Its crop contained 7 large green palm fruits, and 17 blueberry-like fruits known locally as "barberry".

Zenaida aurita aurita (Temminck)

MARTINIQUE DOVE

Mountain Dove

Common and generally distributed. In February 1937 we observed it in many localities, but it was particularly abundant in a wooded gully north of Plymouth, and in the vicinity of Fox's Bay Pond. Although I am listing all the Zenaida doves of the island under this name, doubtless both *Z. a. zenaida* and this forth both

occur, and in fact all of the three specimens collected are intermediate between the two forms. Their crops contained exclusively lime seeds, 49, 77 and 83 seeds being found per bird. These must have been obtained from rotten or overripe fruit, as these soft-billed birds would scarcely be able to open sound limes.

Columbigallina passerina nigrirostris Danforth

ST. KITTS GROUND DOVE

Ground Dove

Fairly common in the vicinity of Plymouth; not observed elsewhere. A male collected on February 8, and a female on February 12, 1937 had the bills entirely dusky. Ground pearls (*Margarodes formicarum*) formed 52.5 per cent of the contents of their crops, one bird having consumed 71 and the other 50. The seeds of *Typhalea* formed 7.5 per cent, and other seeds 40 per cent of the contents.

Oreopeleia mystacea mystacea (Temminck)

BRIDLED QUAIL DOVE

Partridge

Rather rare. Three were noted on St. George's Hill on February 15, 1937, and two at Woodlands on February 18. Later R. A. Tonge sent males collected at Olveston Mountain March 14, 1937 and Jubilee Mountain September 30, 1937, and a female at Woodlands Mountain July 8, 1937.

Coccyzus minor dominicae Shelley

SHELLEY'S MANGROVE CUCKOO

Coucou Manioc

Fairly common, a few being observed in most of the localities visited. Three males collected in February, 1937 are much darker below than specimens of *rileyi* or *vincentis* in my collection, and undoubtedly represent *dominicae*. They measure, wing 134.6–140.8 (137.3); tail 162.2–162.9 (169.6); culmen from base 32.5–34.6 (33.7); tarsus 29.7–31.8 (30.7) millimeters. Their stomachs contained katydids (*Microcentrum* sp.) 60 per cent; long-horned grasshoppers (*Neoconocephalus triops macropterus*) 33.3 per cent, and Coleoptera 6.7 per cent.

Orthorhynchus cristatus exilis (Gmelin)

GILT-CRESTED HUMMINGBIRD

Abundant near the coast, and a few were observed in the mountain forests. A male was collected at Plymouth on February 8, and another on Olveston Mountain on February 11, 1937.

Sericotes holosericeus holosericeus (Linnaeus)

BLUE-BREASTED HUMMINGBIRD

Much less common than the previous species; observed only near Plymouth, on St. George's Hill, and at Woodlands. The stomach of a male collected at Plymouth on February 12, 1937 was filled with minute insects.

Eulampis jugularis (Linnaeus)

GARNET-THROATED HUMMINGBIRD

Fairly common in the forests on Soufriere Mountain, Olveston Mountain, and at Woodlands. A pair was collected on Soufriere Mountain on February 9, and two males at Woodlands on February 18, 1937. Small spiders formed 88.7 per cent, Coleoptera 6.3 per cent, and a Dolichopodid fly 5 per cent of the contents of the four stomachs.

Megaceryle alcyon alcyon (Linnaeus)

BELTED KINGFISHER

Not seen in the course of our work, although the species is well known as a winter resident in Montserrat. Sturge sent a female to the British Museum. Grisdale saw it frequently in February, 1881, and Dr. Pilkington procured one for him. Nicoll shot a female on February 11, 1904. R. A. Tonge has sent me a specimen obtained at Isles Bay in the spring of 1938.

Tyrannus dominicensis vorax Vieillot

LARGE-BILLED KINGBIRD

Rather common in the vicinity of Plymouth, and at Elberton on February 12, 1937 a congregation of fifty or more was noted on a hill near the pond. Two females which were collected from this group are as light as any specimens of *T. d. dominicensis* in my collection. The culmen from base measures 31.3 and 32.7, and the

width at frontal antiae 15.5 and 16 millimeters. These measurements are larger than the average for *dominicensis,* so the specimens are probably best regarded as intermediate between *dominicensis* and *vorax.*

One stomach contained 7 syrphid flies (*Volucella obesa*), while the other had 6 *Volucella obesa* and 5 stratiomyid flies (*Hermetia illucens*).

Elaenia martinica riisii Sclater

RIISE'S ELAENIA

Common and generally distributed, although found most abundantly at lower elevations. Six specimens (three males and three females) were collected at Plymouth, Soufriere Mountain, Cassel's Peak, Olveston Mountain, and Woodlands. As I have shown elsewhere (Journal of the Barbados Museum and Historical Society, V, 1938, p. 123), these specimens are referable to *riisii.*

The six stomachs contained exclusively drupes and berries, among which the fruits of some wild species of *Solanum* amounted to 17 per cent.

Progne dominicensis (Gmelin)

CARIBBEAN MARTIN

Swallow

Small numbers were observed at Plymouth on June 30 and August 13, 1935, and at Fox's Bay Pond on February 12, 1937. Not previously recorded from the island.

Margarops fuscatus densirostris (Vieillot)

DARKER PEARLY-EYED THRASHER

Thrush

Found in practically all wooded regions, but particularly common on the lower wooded hills and in densely wooded ravines in the coastal region. *Densirostris* is a rather dubious race, but if it is to be recognized Montserrat birds must be referred to it. A male was collected on the Soufriere Mountain February 9, 1937, a pair (at one shot) near Plymouth on February 12, and a female at Fox's Bay Pond the same day.

The contents of the four stomachs consisted of walking sticks 25 per cent; weevils 2 per cent; a large spider 5 per cent; berries 63 per cent; and drupes 5 per cent.

Allenia fusca (P. L. S. Müller)

SCALY-BREASTED THRASHER

Black-billed Thrush

On Montserrat this species is scarcer and shyer than *Margarops*. Three were observed on the Soufriere Mountain on February 9, two on St. George's Hill February 15, and fifteen at Woodlands on February 18, 1937. On the latter occasion a female was taken. Its stomach was filled with drupes.

Cinclocerthia ruficauda pavida Ridgway

ST. KITTS TREMBLER

Trembling Thrush

Far from common on Montserrat. One was observed singing on February 9, 1937 at the edge of the tree fern forest on the Soufriere Mountain; another was seen at a slightly higher altitude on Cassel's Peak on February 16, and five at an altitude of only 800 feet at Woodlands on February 18, when three males were collected. These are much more rufescent above, and to some extent below, than *C. r. tenebrosa* from St. Vincent. They measure: Wing 96.2–103 (99.9); tail 80.7–85.4 (83.6); culmen from base 37.5–39.8 (38.8); tarsus 30.3–32.8 (31.5) millimeters.

The specimens all had the iris light yellow, bill black, legs and feet yellowish brown, somewhat tinged with dusky; claws dusky yellowish brown; soles of feet dull yellow.

The three stomachs contained land snails (identified by Dr. Paul Bartsch as *Helicina fasciata* Lamarck), 36 per cent; a large spider 13.3 per cent; katydid nymphs (*Microcentrum* sp.), 26.7 per cent; a long-horned beetle (*Elaphidion* sp.), 4 per cent; weevils 1.7 per cent; other beetles 5 per cent; soft-meated seeds, 13.3 per cent.

Cichlherminia lherminieri lawrencei Cory

MONTSERRAT FOREST THRUSH

Yellow-legged Thrush

Rare and shy, occurring only in the mountain forests. A female was collected at about 2,500 feet elevation on the Soufriere Mountain on February 9, and a bird was observed on Cassel's Peak February 16, 1937. R. A. Tonge sent a male collected on Jubilee Mountain September 30, 1937, a female from Gage's Mountain August 4,

1938, and a pair from the same locality August 6, 1938. These specimens exhibit the color differences noted by Ridgway (U.S.N.M. Bulletin 50, IV, 1907, p. 75) as distinguishing *lawrencei* from typical *lherminieri*. Also *lawrencei* seems to average somewhat smaller. Two males from Montserrat measure, wing 127.8–130.7 (129.2); tail 86.4–89 (87.7); culmen from base 28.3–30.6 (2.94), and tarsus 39.7–41.7 (40.7) millimeters, while three females measure wing 131.6–136 (133.8); tail 92.7–95 (93.8) in two; culmen from base 29.6–30.5 (30.0), and tarsus 41–42 (41.6) millimeters. Two adult males of *C. l. lherminieri* from Guadeloupe in my collection measure: wing 137.1–139 (138); tail 91.2–92.8 (92); culmen from base 29.9–31.1 (30.5); tarsus 41.6–42.6 (42.1) millimeters.

The adult female *lawrencei* collected had the bare orbital space, bill, legs and feet, including the claws and soles, bright orange yellow, except that the upper mandible was more or less tinged with dusky. The iris was hazel. Its stomach contained about equal parts of insect remains and fragments of fruits.

Vireo calidris barbadensis (Ridgway)

BARBADOS VIREO

Common at lower elevations, but not observed in the mountain forests. None were observed during the first few days of our visit, but on February 10 many were seen and heard singing in the very same area near Plymouth where none had been recorded a few days previously. From that date on the species was observed commonly Males were collected near Plymouth on February 10 and 12, and a pair on St. George's Hill on February 15, 1937. Drupes constituted 50 per cent, Coleoptera 25 per cent, and a large Coleopterous larva 25 per cent of the contents of the four stomachs.

Coereba bartholemica (Sparrmann)

ST. BARTS HONEY CREEPER

Yellow-breast

Common at lower elevations; scarce in the mountain forests. Two females were collected on Olveston Mountain February 11, a female at Plymouth, February 12, and a male on Cassel's Peak February 16, 1937. I cannot distinguish these from specimens from the more northern Lesser Antilles or Guadeloupe, and consequently consider that *dominicana* must be regarded as a synonym of *bartho-*

lemica. One of the females has a decidedly white front, and another shows some indications of white in that region. The male measures, wing 59.8; tail 38.8; culmen from base 16; tarsus 18.5, and the three females, wing 57–62.4 (58.8); tail 37.8–41.5 (39.3); culmen from base 16.1–17 (16.5); tarsus 18–18.2 (18.1) millimeters.

One stomach was empty. The others contained exclusively insects and their larvae, among which Coleoptera 32 per cent and lepidopterous larvae 50 per cent were recognizable.

Mniotilta varia (Linnaeus)

BLACK AND WHITE WARBLER

A female was collected in a ravine north of Plymouth on February 12, and an individual was noted at Woodlands on February 18, 1937. The stomach of the specimen collected contained comminuted insects and their larvae, including weevils and other Coleoptera, and lepidopterous larvae. Previously recorded by Bond.

Compsothlypis americana pusilla (Wilson)

NORTHERN PARULA WARBLER

Observed near Plymouth on February 7 and 8, 1937. Nicoll found the species fairly common and shot two on February 11, 1904.

Dendroica petechia bartholemica Sundevall

ST. BARTS GOLDEN WARBLER

Fairly common in dry scrub near Plymouth; also observed in manchineels along the coast. A male was collected on February 10, and a female February 12, 1937 in scrub country near Plymouth. The male has scarcely any chestnut on the crown, in which respect it resembles other males of its race in my collection. It measures, wing 63.6; tail 51.6; culmen from base 15; tarsus 22 millimeters, and the female, wing 57.7; tail 47; culmen from base 14.2, and tarsus 20.6 millimeters. Their stomachs contained fragments of insects and their larvae, including Chrysomelidae 10 per cent, other Coleoptera 37.5 per cent, and lepidopterous larvae 30 per cent.

Dendroica tigrina (Gmelin)

CAPE MAY WARBLER

Recorded by Bond.

Dendroica dominica dominica (Linnaeus)

YELLOW-THROTED WARBLER

Nicoll records one shot in thorn bushes along the shore on February 11, 1904.

Dendroica discolor discolor (Vieillott)

NORTHERN PRAIRIE WARBLER

One was shot in dry scrub country near Plymouth on February 10, and two were seen and one collected there on February 12, 1937. The stomach of the latter contained a spider and various insects, including Coleoptera. Previously recorded by Bond.

Seiurus aurocapillus (Linnaeus)

OVEN-BIRD

Recorded by Bond.

Seiurus noveboracensis (Gmelin)

NORTHERN WATER-THRUSH

One was seen in the mangroves at Fox's Bay Pond on February 12, 1937, constituting the first record for the island.

Seiurus motacilla (Vieillot)

LOUISIANA WATER-THRUSH

Recorded by Bond.

Setophaga ruticilla (Linnaeus)

AMERICAN REDSTART

Many were seen, including some in bright male plumage, and others in female or immature male plumage, from February 9 to 16, 1937 in all parts of the island from mountain forests to the coast. An immature male collected on the Soufriere Mountain on February 9, 1937 had eaten fleabeetles, weevils and Diptera. Nicoll obtained one and saw others on February 11, 1904.

Icterus oberi Lawrence

MONTSERRAT ORIOLE

Tanya Bird

This, the only distinct species confined to Montserrat, occurs in forests on the Soufriere and also on Olveston Mountain in the Centre

Hills, and down to as low as 800 feet elevation at Woodlands, so it is by no means confined in its distribution to the Soufriere Mountain, as has previously been supposed. A total of eight specimens were obtained (including some sent by R. A. Tonge since our departure), obtained on the Soufriere Mountain, Cassel's Peak Chance's Mountain, Rendezvous Mountain, Woodland Mountain, and at Woodlands. In these, there are five adult males, one immature male, and two adult (?) females. There has been some doubt concerning the plumage of the adult female of this species. If these two females are indeed adult, then the female plumage is indistinguishable from that of the immature male. Three of the specimens obtaind by Ober, which I have examined in the Field Museum, are in this plumage, and are marked immature female. Possibly they are actually adult, as no females appear to have been collected in any other plumage.

The song of this species was not heard. The call note is similar to that of *I. portoricensis* but not quite so loud.

An adult male and a female collected on Cassel's Peak February 16, 1937 both had the iris dark brown; upper mandible black, the lower light slate blue except for the median surface, which was black, and the extreme tips of both mandibles light horn color; legs and feet light slate blue, the soles tinged with yellow, and the claws bluish slate. An immature male collected at Woodlands February 18, 1937 was very similar.

One stomach was nearly empty, containing only single weevil. Another contained a rotten cane borer weevil (*Metamasius hemipterus*), 3 lepidopterous larvae, 6 cockroach oöthecae, and some miscellaneous insect fragments.

Holoquiscalus lugubris guadeloupensis (Lawrence)

GUADELOUPE GRACKLE

Blackbird

Mr. English informs me that this species was well established in Montserrat at the time of his arrival in 1919, but that he has heard conflicting tales concerning which island was the source of the stock used for introduction. There are no references in the literature prior to Bond (1936). It is even now far from common. On July 31, 1931 I observed a few in mangroves near Plymouth, and in 1937 a

few were seen near Fox's Bay Pond, and in the growth back of beaches near Plymouth, where an apparently mated pair was collected on February 12. These agree well with specimens from Guadeloupe in my collection. The female is much lighter than specimens of *inflexirostris*. The male measures: Wing 124.5; tail 103; culmen from base 32; tarsus 34.8 millimeters, and the female, wing 105.2; tail, in molt; culmen from base 28.7; tarsus 31.6 millimeters.

There is some possibility that the species is a recent arrival from Guadeloupe and was not introduced, but it seems highly improbable that it could have existed in the island for long, since so conspicuous a bird could hardly have been overlooked by the earlier collectors.

The stomach contents of the pair collected consisted of *Anolis* lizards 75 per cent; mealybugs, *Pseudococcus* sp., (40 in one stomach), 15 per cent; Coleoptera 6 per cent, and spiders 4 per cent.

Tanagra flavifrons flavifrons (Sparrmann)

GREEN EUPHONIA

Heard calling on several occasions in February, 1937 in the forests on Soufriere Mountain, Cassel's Peak, Olveston Mountain, and at Woodlands, but it proved impossible to collect any.

Tiaris bicolor omissa Jardine

CARIB GRASSQUIT

Abundant in the vicinity of Plymouth; not seen elsewhere. Two males and a female were collected in February, 1937. On June 30, 1935, a nest and two eggs were collected seven feet from the ground in a manchineel tree near the beach. The female emerged from the nest, and scolded vigorously as it was being collected. The eggs are white, more or less uniformly covered with fine red speckles. One measured 16.4 $\times$ 12.8 millimeters, the other was broken before it could be measured.

Three stomachs contained seeds of grasses and other small seeds, with the addition of sand for grinding purposes.

Loxigilla noctis dominicana (Ridgway

DOMINICA BULLFINCH

Rather uncommon; during the course of our field work exactly 16 birds were noted. These were found widely scattered and in many types of country, ranging from dry scrub near Plymouth to

mountain forest on Soufriere Mountain and Cassel's Peak. Two adult males and three females were collected. These agree well with specimens from Guadeloupe and Dominica, and are regarded as *dominicana*. Two males measure: Wing 70–70.1 (70.05); tail 50–52.3 (51.15); culmen from base 16.4–16.7 (16.55); tarsus 19.3–20.3–19.8 millimeters, and three females, wing 61.8–65 (63.8); tail 45–49.3 (47.4); culmen from base 15.3–15.6 (15.4); tarsus 19–19.6 (19.4) millimeters.

The stomachs of the five birds collected contained small seeds 80 per cent and fruit pulp 20 per cent, plus sand or gravel for grinding purposes.

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INTRODUCTION AND COLONIZATION OF TWO PARASITES OF THE PINEAPPLE MEALYBUG IN PUERTO RICO

By KENNETH A. BARTLETT *

Mealybug is the most important insect pest of pineapples in Puerto Rico.

The pineapple mealybug, *Pseudococcus brevipes* (Ckll.), is the most serious insect pest of pineapples in Puerto Rico and is widely distributed over the island. It attacks the roots, leaves, and fruits of all varieties thus far grown in the island.

Experiments in the Hawaiian Islands have shown that the mealybug secretes a toxin into the pineapple plant which causes a wilted, flaccid appearance, which varies considerably with the varieties attacked. Where the mealybugs colonize in large numbers, widespread crop failure may be caused in the more susceptible varieties.

In an effort to reduce the population of the mealybug by natural means and thus to supplement cultural and other artificial control measures, the United States Department of Agricelture began the introduction into Puerto Rico of mealybug parasites early in 1936 from field explorations conducted under processing tax funds by the Bureau of Entomology and Plant Quarantine. Further introductions were made during the next year by the Puerto Rico Experiment Station of the same department at Mayagüez. The present paper records these introductions and the rearing, colonization, and recovery of the parasites in the pineapple regions of the island.

Importations of mealybug parasites were made from Brazil and Hawaii.

The first shipments of pineapple mealybug parasites, totaling 47 adults of *Anagyrus coccidivorus* Doz., were received by air express directly from Brazil in 1936. Of these 10 adults were liberated but

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the remainder could not be successfully reared for mass liberation. Further introductions of this species and of another, *Hambletonia pseudococcina* Comp., were made from Brazil and Venezuela vía Hawaii in 1937, and these parasites were successfully reared in the laboratory and liberated in Puerto Rico. The shipments coming directly from Brazil were made by D. T. Fullaway, at that time of the Bureau of Entomology and Plant Quarantine. The later shipments from Hawaii were assembled by Mr. Fullaway, then of the Board of Commissioners of Agriculture and Forestry, Territory of Hawaii, cooperating with Walter Carter, Entomologist, Pineapple Experiment Station, University of Hawaii at Honolulu. All of this later material was sent to Puerto Rico by air express, and the mortally en route was negligible. Table 1 is a summary of the introductions of pineapple mealybug parasites made during 1936 and 1937.

TABLE 1—THE INTRODUCTION INTO PUERTO RICO OF TWO PARASITES WHICH ATTACK THE PINEAPPLE MEALYBUG, *PSEUDOCOCCUS BREVIPES*, GIVING DATES, COUNTRIES OF ORIGIN, SPECIES, AND NUMBERS INTRODUCED

Dates	Countries of origin	Species introduced	
		Anagyrus coccidivorus	*Hambletonia pseudococcina*
		Numbers	*Numbers*
February and March 1936.	Brazil.	47	. .
January 4, 1937	Venezuela[1] . . .	. . . . . .	54
May 6, 1937	Brazil[1]	75	
Total	. . .	122	54

[1] Received via Hawaii.

With the exception of 10 adults of *A. coccidivorus* received in March 1936 all of the parasites were retained in the laboratory for rearing purposes.

Hambletonia pseudococcina **was successfully reared in the laboratory.**

Breeding work with *Hambletonia pseudococcina* was started in January 1937. The first generation reared was not particularly successful, and only two females survived. Fortunately, the species reproduces parthenogenetically and the succeeding generation produced 20 females. Numerous variations in the breeding technique were tried in which various types of cages were employed. Eventually, however, the use of a cage designed and used successfully in Hawaii by Walter Carter (1) was adopted and placed in general usage.

The cage used consisted of a celluloid cylinder with cloth ends which may be tied in about the stalk of the pineapple plant and held

by a support above. Entrance holes and ventilation were provided by openings in the celluloid cylinder. The method followed here was not to infest the fruit by the placing of mealybugs directly on the plant, but to place heavily infested leaf cuttings in the cage, completely surrounding the fruit. From these the young mealybugs readily passed to the fruit and were also carried there by ants, which while not entirely eliminated were never allowed to become numerous. The adult parasites were introduced at the same time as the mealybugs, and many of the mealybugs on the leaves became parasitized and remained settled in position. The parasitized mealybugs on the leaves were removed just prior to expected emergence and the fruit left intact. The fruit which soon became well infested produced some parasites which then proceeded to parasitize the new developing generation of mealybugs, and usually an excellent second generation of parasites thus resulted. The foregoing method eliminated the labor of infesting the fruit by hand, which is time-consuming and difficult to accomplish without injury to the mealybugs. Five adult parasites were usually placed in each cage to start a new generation. This breeding work with *Hambletonia pseudococcina* was discontinued in March 1938 after 6,917 adults had been reared.

Females produced parthenogenetically but males occurred occasionally.

The strain or race of *Hambletonia pseudococcina* received from Hawaii was able to reproduce parthenogenetically but males also occurred. Of the 6,917 adults reared in the laboratory, 40 were males. Mating seemed to take place normally, but the sex ratio among the resulting progeny was apparently no different from that among progeny from parthenogenetic females. Carter (1) states that the Brazilian strain of *H. pseudococcina* is bisexual but that the material he has studied from Colombia and Venezuela reproduced parthenogenetically.

In mating a long courtship was noted to take place. The male took up a position directly in front of the female caressing her with his antennae and preventing any forward movement on her part. As the female turned to escape the male also turned and maintained his position. This procedure continued for several minutes until the male suddenly mounted the female, the period of copulation was always short and was seldom observed to be over 10 seconds.

Oviposition by this parasite has been observed only in half-grown or larger mealybugs. The procedure followed was for the female parasite to crawl about the plant until it had located a suitable

mealybug. This done, the parasite caressed the mealybug for some seconds with its antennae, them quickly reversing its position it backed up, and inserted its ovipositor at the nearest point in the body of the mealybug. Oviposition was noted to continue over a period of time, during which a considerable number of mealybugs could be parasitized by one female.

The females are apparently gravid and able to oviposit at the time of emergence or shortly thereafter; specimens have been reared from mealybugs which were exposed to newly emerged females for a period of only a few hours. At the end of about 18 to 20 days after oviposition the parasitized mealybugs became mummy-like in appearance and in some cases gave the superficial appearance of dipterous puparia. The period from oviposition to initial emergence varied from 24 to 30 days, with the greater majority of the parasites emerging at the end of 26 days.

Three parasites were reared from a single parasitized mealybug.

A group of 25 pineapple mealybug mummies, parasitized by *Hambletonia pseudococcina* was removed from a plant just prior to their expected emergence and placed in separate vials. Parasites emerged from 17 of the isolated mummies: 9 produced a single parasite each, 7 produced 2 parasites each, and 1 produced 3 parasites. In all but one instance the multiple emergence occurred on the same day; in this instance a male, the only one reared from this material, emerged 2 days after a female had emerged from the same mealybug.

***Anagyrus coccidivorus* was reared in the laboratory.**

Adults of *Anagyrus coccidivorus* were received from Hawaii in May 6, 1937 and a breeding program was imediately started. "Carter Cages" were used almost exclusively and gave excellent results. The period of development for this species was somewhat shorter than for *Hambletonia,* varying from 19 to 21 days from oviposition to emergence. From May 1937 through December 1938 a total of 9,673 individuals was reared, 4,545 males and 5,128 females. The males usually emerged 1 to 2 days previous to the females. Mating took place readily shortly after the females emerged in the cages or in glass vials.

It is of interest to note that Dozier(2) originally described this species from Haiti as a parasite of *Pseudococcus virgatus* Ckll. The present parasite material, which came from Hawaii, was originally collected in Brazil by D. T. Fullaway from *Pseudococcus brevipes.*

Liberations of pineapple mealybug parasites were made throughout the island.

Liberations of *Hambletonia pseudococcina* and *Anagyrus coccidivorus* were made throughout the pineapple-growing sections of the island as fast as the parasites could be reared. Table 2 which follows summarizes these liberations.

TABLE 2—THE LIBERATION OF *HAMBLETONIA PSEUDOCOCCINA AND ANAGYRUS COCCIDIVORUS* IN PUERTO RICO, GIVING LOCATIONS, DATES, AND NUMBERS LIBERATED

Locations	Dates	Liberations	
		Hambletonia pseudococcina	*Anagyrus coccidivorus*
		Numbers	Numbers
Arecibo	April 1937 to May 1938	[1] 2,116	...
Arecibo	March 1936		10
Arecibo	June 1937 to July 1938		3,184
Bayamón	November to December 1938		277
Lajas	May to August 1938		3,687
Lajas	April to October 1937	[2] 1,711	....
Mayaguez	June 1937 to June 1938	345	.
Corozal	June 1937	950	...
Toa Alta	July 1937	[3] 1,071	....
Total		6,193	7,158

[1] Including 13 males.
[2] Including 11 males.
[3] Including 9 males.

***Hambletonia pseudoccocina* has become well established in various localities.**

The first recoveries of *Hambletonia pseudococcina* were made at Lajas on May 7, 1937, when two specimens emerged from mealybugs brought into the laboratory from that locality. Since that time, frequent recoveries have been made; in February 1938, adults were found at Lajas, and one plant examined showed 38 parasitized mealybug mummies to be present; examinations a month later showed that nearly all infested plants harbored parasitized mealybugs. In January 1939, observations showed this parasite to be present in all the fields examined in four separate localities about Lajas, and parasitized mealybugs were readily collected in large numbers throughout this area.

In March 1938, recovery of four adults was made from mealybugs collected at Arecibo. In September 1938, a recovery was made at Las Mesas, Mayagüez. It appears from the foregoing that this species is well established, and it is hoped that some reduction in the pineapple mealybug infestation will result from its introduction.

Anagyrus coccidivorus has not been recovered to date. Liberations will therefore be continued with the expectation that this species may also become established and aid in the control of the pineapple mealybug.

LITERATURE CITED

(1) **Carter, Walter.** The importation and laboratory breeding of two chalcid parasites of *Pseudococcus brevipes* (Ckll.) Jour. Econ. Ent. 30, (2): 370–372, 1 Fig. 1937.

(2) **Dozier, Herbert L.** An important new encyrtid parasite of the mealybug, *Pseudococcus virgatus* (Ckll.). Proc. Ent. Soc. Wash. 34, p. 8, 1 Fig. 1932.

THE NOMENCLATORIAL STATUS OF THE GENUS DIMERIELLA SPEG. [1]

By Rafael A. Toro (1)

Among the genera comprising the family Perisporiaceae of the ascomycetous order Perisporiales, no other genus has been subjected to a wider range of interpretations, than *Dimeriella*. This is one of the genera included by Theissen (**24**) under the general term Dimerinae. The Dimerinae comprises a small number of forms characterized by minute fruiting bodies, light colored, thin, non-hyphopodiate mycelium, and small, two-celled, hyaline or light brown spores. The majority of these forms occur as parasites on leaves or on the mycelium of other fungi and include species formerly assigned to *Dimerosporium* Auct. (not Fuckle).

From a study of the existing literature it is evident that the various authors who have studied species of *Dimeriella* do not have a clear understanding of the genus-concept. For some has had a Sphaeriaceous, Microthyriaceous or Perisporiaceous meaning; while for others, it has been even Capnodiaceous. One wishing to offer a comentary for such discrepancies has only to consider the original description and the species mentioned under it. The vagueness expressed by Spegazzini's (**21**) concept "genus e Dimerosporio excerptum", lay oneself open to a misunderstanding of its true meaning; and a comparative study of the eight species placed originally under *Dimeriella*, leaves no doubt that its author did not have a clear picture of the older genus *Dimerosporuim* Fuckle. In order to illustrate the writer's point the folowing synopsis of the disposition of Spegazzini's species of *Dimeriella*, made by later authors, is presented.

Table I—SYSTEMATIC ARRANGEMENT OF THE ORIGINAL SPECIES

Spegazzini's species of *Dimeriella*	Other Author's Disposition	
	Transfer to	Author
dubiosa	*Gibbera-Antenularia*	Von Hohnel
Asterinarum	*Phaeodimeriella*	Theissen
guarapiensis	*Phaeodimeriella*	Theissen
solanicola	*Phaeodimeriella*	Theissen
Elliotti		
coronata	*Acanthostoma*	Theissen
Meyer-Hermani	*Dimerium*	Theissen
hirtula	*Asteromyxa*	Theissen and Sydow

(1) Contribution from the Laboratories of Cryptogamic Botany and the Farlow Herbarium, Harvard University No. *170*, and from the Department of Botany and Plant Pathology, College of Agriculture and Mechanic Arts, University of Puerto Rico No. *10*.

As is shown in the above table, only one of the eight species originally placed in the genus has been retained, and this is known only from the description, the specimen having been lost. However, any consideration of the validity of *Dimeriella* rests upon an appreciation of whether the first mentioned, or the first described, species is the type. This necesitates a discussion of the circumstances involving *D. dubiosa* (Speg.) Speg. and *D. hirtula* Speg., respectively.

Dimeriella dubiosa (Speg.) Speg. (Pl. Paraguay, Balansa No. *3539*) was originally described as *Dimerosporium ? dubiosum* Speg. and later it was transferred as the first species under his genus *Dimeriella*. The fungus forms compact, indefinite, black, subiculate, raised ,separate spots on leaves of *Bambos*. The,long, densely stromatoid, brown mycelium which is septate, is fastened to the subcuticular layer of the leaf tissue. The few to many round, perithecia or picnidia are brown, ostiolate and adorned at their lower portion, with short, thick, closely septate setae. Paraphyses accompany the cylindrical asci. The two-celled, hyaline spores are elliptico-lanceolate.

Dimeriella hirtula Speg. (Uster, Ipiranga, Brazil) is the first species which has been described and figured. It occurs on leaves of *Baccharis,* where it forms loose colonies. The fruiting bodies are dimidiate thyriothecia with thin, septate setae radiating from their lower portions. The mycelium is scanty, brown pellucid, thin and not stromatoid as in *D. dubiosa.* The egg-shaped asci are immersed in a gelatinous paraphysoid body; while the two-celled spores are hyaline at first, becoming light brown with age.

Of the eight original species included under *Dimeriella,* the two just mentioned and five others have been transferred to other genera. *Dimerosporium ? dubiosum* Speg. became *Antennularia ? dubiosa* (Speg.) Th. (**24**). *Dimeriella hirtula* Speg. was made the type of the genus *Asteromyxa* Th. et Syd. (**27**) and the remaining species were placed in the genus *Phaeodimeriella* Speg. and others. Later Theissen & Sydow (**27**: 462) restored the name *Dimeriella* Speg. as a genus of the Perisporiaceae, broadened its concept and selected as its type a different species, *Dimerosporium Cordiae* P. Henn. It is in this last sense that recent authors use the name.

It is altogether evident that there has been expressed three different concepts of *Dimeriella* and, therefore, the validity of the genus is rather doubtful. If the first described species is to be considered as the type, then *Dimeriella* Speg. belongs to the Microthyriaceae and *Asteromyxa* Th. & Syd. becomes a synonym. If on the other hand,

we designate the first species mentioned as the type, the genus becomes a synonym of *Gibbera* Fckl. Theissen (l.c.) in his revision of the genus *Dimerosporium* transferred the species mentioned by Spegazzini to *Antennularia ? dubiosa* (Speg.) Th. with the caption "Ist eine Gibbera-Antennularia". Already v. Hohnel (**9**) has shown that *Antennularia* Reich. is one of the fungi imperfecti representing pycnidial stages of *Coleroa* or *Gibbera.* We have compared Spegazzini's specimen and it agrees with the latter genus. Whether *Dimeriella* Speg. could be accepted as a valid generical name depends on the justification of Theissen and Sydow (l.c.) in selecting a new type. We believe this is contrary to the accepted rules of nomenclature and therefore the name should be discarded. The present species can be distributed among the already existing genera of the ascomycetes.

A consideration of the systematic position of the group to which *Dimeriella* Speg. has been assigned, seems appropriate at this time. The genus has been considered a member of the order Perisporiales, as established by Lindau (**13**). This order consisted of three families, namely: Erysiphaceae, Perisporiaceae and Microthyriaceae. In the light of our present knowledge of these families, it is evident that its author merely regarded the group as a temporary resting place and considered the fructifications as perithecia borne on aerial mycelium. The absence of an evident ostiolum justified their treatment together. Subsequent works on the group, tending to clarify the situation, has thrown much light on the subject.

The Microthyriaceae, on account of their shield-shaped, inverse radiate fruiting bodies were first seggregated by Theissen (**26**) and placed in a new order, the Hemisphaeriales. Furthermore, Theissen and Sydow (l.c.) subdivided the Perisporiaceae of Lindau into three families, Capnodiaceae, Perisporiaceae and Englerulaceae, and together with the Erysiphaceae treated them under the Perisporiales.

The term Perisporiales has been a matter of discussion. The name is based on the genus *Perisporium* Fr. whose type species has been shown to belong to the Imperfecti genus *Crocicreas* by Saccardo (**20**) while Petrak and Sydow (**16**) consider it to be a juvenile stage of a Discomycete. In view of this fact, Gwynne-Vaughan (**8**) has proposed the name *Erysiphales* for the order, basing the proposition on *Erysiphe*, the next oldest genus name. In this she has been followed by Bessey (**4**). However, Fitzpatrick (**5**) has elevated the Erysiphaceae to ordinal rank, restricting the term Erysiphales to this family. Such change is based upon Miller's (**14**) recent studies on the differences in origin of the ascocarps. The Capnodiaceae have been investigated by Arnaud (**3**) and regarded as Sphaeriaceae

related to the Lophiostomataceae. Woronichin (29) however, insists that the Capnodiaceae form a well delimited group of ordinal rank for which he proposes the name Capnodiales. All of the genera of the Periosporiacea and Englerulaceae so far investigated have been shown to belong to the Pseudosphaeriaceae or to the Dothidales (7) (19) (14).

This has resulted in a great deal of shifting of the genera originally included in the Perisporiales. This situation caused Petrak (18) to say that "weil man heute noch gar nicht weiss, was weine Perisporiazee ist und wie ein Pilz beschaffen sein muss, um als Perisporiazee geten zu konnen." Furthermore, Nannfeldt (15) in his very complete discussion of the morphological relationships existing among the Ascomycetes, failed to treat the Perisporiales as such, but remarks in a foot-note "Der Ordnung Perisporiales felht jedlich Existenzberechtigung." Arnaud (1) also considers the Perisporiaceae as a 'groupe sans valeur aucune".

The writer's own observations on species of *Meliola* Fr. and of the *Dimeriella,* herein discussed, have convinced him that both these genera do not correspond with the definition of Theisse nand Sydow (l.c. 447) "angiocarpen Askomyceten mit mundunglossen kugeligen Gehäusen". These authors include in the Family Perisporiaceae 19 genera and four additional doubtful ones. Of these *Lasiobotrys* Kunze was studied by v. Hôhnel (11), Arnaud (1) and Petrak (17) and all agree on its exclusion from the Family. Arnaud (2) transferred *Parodiopsis* Maubl. and *Perisporina* P. Henn. to his family Pariodiellinacees, while *Chrysomyces* Th. & Syd. and *Piline* Th. are given as synonyms of the former. *Meliola* Fr., *Irene* Th. & Syd. and *Meliolina* Syd. are certainly related to the Dothideales (1) (7) (14). As will be shown in a subsequent paper, the asci are borne in a locule and the fruit body is a stroma. Arnaud (1) points out that *Dimerium* Sacc is Sphaeriaceous.

Though natural relationships among the Ascomycetes can only be obtained through studies of their life histories, these are not possible in general classificational work. The taxonomist must depend on the gross morphology of the species in question for its determination. From the few life history studies on this group, certain facts have been obtained which help in correlating characters of asci, paraphyses and spores with the type of development. It has been demonstrated by Killian (12), Frey (6), Miller (14) and others that in the Pseudosphaeriacea the ascogenous hypahe lie from the beginning enclosed in a stromatic tissue and gradually. by pressure or

resorption this tissue is pushed away to permit the development of asci. Each ascus is separated from the other by intervening remnants of stromatic tissue which forms elongate, compressed, paraphyses-like threads. When the asci are close together, as in this group, this tissue can be easily mistaken for paraphyses; except for the fact that is fastened above and below to the inner wall of the fruiting body. This is especially evident in young ascocarps.

Correlated with this structure is the arrangement of the asci in a parallel layer standing more or less close together and at the same height. On account of having to push their way thru the tissue and the subsequent formation of the locule, the asci in this group are thick walled, especially so at the apices. This condition causes them to be either ovoid or clavate and their dehiscense is by rupturing of the walls. Certainly they are never thin walled in the main body and slightly thicker at the apex or operculate. However, there is no uniformity in spore size or shape.

The crucial structure in the group is the fruiting body,which, though called a perithecium by most mycologists, it is a stromatic organ of vegetative origin. Miller (l.c.) has demonstrated that the perithecium, the typical structure of the pyrenomycetes, has its origin in the sexual apparatus. It is usually of light color and in the majority of the cases is protected by a stroma. Therefore most of the pyrenomycetes are stromatic. The typical pyrenomycete is well illustrated in Weston's figures of *Loramyces* (**28**). Their asci are elongated, thin walled and separated by free-ending paraphyses. There is an ostiolum lined by short threads called peryphyceses. On the other hand, though the fruiting bodies of our present Perisporiales are globose and perithecium-like, they nevertheless, are the product of special development in the vegetative cells of the mycelium. At the beginning, the fruiting bodies, which v. Hohnel (**10**) calls pseudothecia, are astomous, but with age, the central portion of the apex breaks away giving them the appearance of ostiola. This phenomenon has been a matter of confusion and has lead to the establishment of a number of so-called Sphaeriaceous genera.

According to Arnaud's (**2**) interpretation the species which are at present included in the genus *Dimeriella* and its related genera *Dimerina, Phaeodimeriella* and *Dimerium* show a very close relationship to the group Parodipsidees. However, there are certain features which justify their consideration as distinct genera of this group. This paper discusses only the *Dimeriella* forms, the remaining genera will be discussed later.

The fruit body of the Parodiopsidees consists of a single layer of colored cells. The abundant mycelium is superficial; setae are either present or absent and the ascospores are light brown and two-celled. The principal difference between this group and the present *Dimeriella* lies in the size, color and consistency of the ascocarps. The *Dimeriellas* have very small fruiting bodies which are light or dark brown when young, and more or less fleshy. However, *Parodiopsis ? manihotis* (P. Henn.) Arn. can be regarded as a *Dimeriella* without setae.

As a basis for the separation of *Parodiopsis* Maubl. and *Dimeriella* Auct. (nec. Speg.) the writer is considering the presence of setae, color of the young ascocarps, and the absence of a recognized conidial stage in the latter.

SYSTEMATIC CONSIDERATIONS

As already stated *Dimeriella* Speg. is one of those concept-genera which, on acount of undefiniteness in characterization, has given rise to a variety of meanings, according to the interpretation given to the fundamental genus *Dimerosporium* Fckl. However, this genus is an *Asterina* with a gelatinous dehiscence. The revision of the genus *Dimerosporium* by Theissen (**24**), showed that the species included under it belong to more than half a dozen genera and that *D. veronicae* Fckl., its type, was its only true representative.

From the present study of the *Dimeriellas* the writer has found that they can be separated in two rather distinct genera, i.e., *Lasiostemma* Th. & Syd., related to Arnaud's Paradiopsidees, including most of the species, and *Neohoehniela* Th. & Syd., which shows affinities with the present Capnodiaceae.

1. LASIOTEMA Th. & Syd. Anal. Myc. **15**: 218. 1917.
   - *Dimeriella* Auct., nec. Speg., p.p.
   Chaetostigme Syd. Anal. Myc. **15**: 199. 1917.
   Capnodinula Speg. Physis **4**: 288. 1918.
   Pseudoperisporium Toro, Sci. Surv. P. R. **8**^{2}: 42. 1926.

Leaf parasite. Mycelium superficial, thin, brown pellucid, straight, septate, branched, without hyphopdia. Ascocarp globose, somewhat papillate rather small, superficial on the mycelium, adorned with numerous setae arising from the outer, somewhat blackened layer of parenchymatous cells, dehiscence by rupture of the thin, brown apical cells. Asci eight spored, clavate, thick tunicate above, numerous, each one separated by a thin septate, hyaline tissue. Spores two-celled, hyaline at first, becoming olivaceous or yellowish with age. Conidial stage unknown.

Type species: *Lasiostemma melioloides* (B. and C.) Th. & Syd.

In Clements & Shear's "Genera of Fungi" p. 54 and 67 this genus is placed in the Perisporiaceae and also in the Sphaeriaceae. In the first family it lies between *Dimeriella* and *Chaetostigme*, while in the second, it is next to *Apiosporina* from which it differs in the absence of an ostiolum. The first relation is to my mind the right one. In a forthcoming article on the status of the genus *Phaeodimeriella* Speg. the writer considers in extenso, his views on the relationships of *Apiosporina.*

It has already been pointed out why *Dimeriella* Speg. ought to be discarded. Although *Chaetostigme* Syd. antedates *Lasiostemma* Th. & Syd., the former genus was established, with a very meager description, as one of those concept-genera. No type specimen was designated at the time, and its only description was "*Dimeriella* aber mit Paraphysen". Later, while discussing a specimen from New Zealand, on *Lagenophora Billardieri*, Sydow (**22**) takes Berkely and Curtis' species *melioloides,* which had been already assigned as the type of *Lasiostemma,* and makes it the type of *Chaetostigme.* He further remarks that *melioloides,* in the sense of Theissen, is a composite species and that his specimen probably constitutes a distinct one. This observation strenghthens our conclusions that *L. melioloides,* is a collection of well defined and distinct species. Since Sydow selected a species which has already been assigned to a well defined genus we are forced to consider his genus *Chaetostigme* as a synonym. Clements and Shear's recognition of *Chaetostigme* and their selection of another species as its type has no justification.

Capnodinula Speg. is based on *Asterella trichodea* Rehm. which Theissen included as a synonym of *L. melioloides.* Because it differs from the latter in the character of the colonies and color of the spores, the writer considers it here as a distinct species.

The genus *Pseudoperisporium* Toro and along with it, the order Pseudoperisporiales has no right of existence. Miller (l. c.) has already defined an ostiolum, on the light of our present knowledge, and the pore formed by resorption of the apical cells to let escape the mature spores, can not certainly be homologize with the canal in the pyerenomycetes.

As originally indicated *Lasiostemma* differs from *Dimeriella* on the position of the seate. *Dimeriella* species are described as with setae on the lower portion of the ascocarps and these are rather short;

while *Lasiostemma* was supposed to include those *Dimeriellas* with long setae on the upper part of the fruit bodies. That this character is a rather weak one to differentiate among genera is shown by *D. Cordiae* P. Henn. which sometimes has ascocarps with setae above the upper middle part; in *D. coronata* Speg. a great number of the setae are on the lower portion. We are extending the characterization of *Lasiostemma* to include not only those whose setae are on the upper part but also those whose seate are located at any place on the ascocarp as previously stated. Their position and length, however, serve to differentiate between species or group of species.

KEY TO SPECIES

A. Fungus not producing leaf discolorations.
  I. Setae mycelium-like
    a. Setal length about twice the diameter of ascocarp, on Carduaceae.
      1. Setae mostly occuring at the apex of ascocarp.
        " Colonies small, black, smooth — 1. *L. melioloides*
        ' Colonies large, brownish-velutinous — 2. *L. distans*
      2. Setae occuring at any place — 3. *L. coronata*
    b. Setal length not exceeding diameter of ascocarp.
        " Spores 10–12 × 4 — 5u, on Borraginacea. — 4. *L. cordiicola*
        ' Spores 15–20 × 5 — 7u, on Poaceae — 5. *L. disseminata*
  II. Setae spine-like, on Ericaceae. — 6. *L. maculosa*
B. Fungus producing reddish discolorations on leaf, on Carduaceae. — 7. *L. gnaphali*

1. LASIOSTEMMA MELIOLOIDES (B. & C.) Th. & Syd. Ann. Myc. **15**: 218. 1917.

Asterina melioloides B. & C., Grevillea **4**: 10. 1875.

Meliola baccharidis B. & Rav., Grevillea **4**: 158. 1876.

Dimersporium melioloides (B. & C.) Martin, Journ. Myc. **1**: 146. 1885.

Dimerosporium baccharidis (B. and Rav.) Sacc., Syll. Fung. **1**: 53. 1882.

Dimerosporium melioloides (B. & C.) Ell. & Ev., N. Am. Pyr. **1892**: 32.

Dimerosporium vestitum Earle, Bull. N. Y. Bot. Gard. **2**: 338. 1902.

Dimeriella melioloides (B. & C.) Th. Ann. Myc. **10**: 1. 1912.

Chaetostigme melioloides (B. C.) Syd., Ann. Myc. **22**: 295. 1924.

Spots none; colonies epiphyllous, separate, rarely confluent, more or less round, black, shiny, compact, forming a superficial easily detachable crust, .5–2mm. diam; mycelium not spreading beyond the individual colonies, septate, yellowish-brown, straight, never anastomosing, without hyphopodia, rather scanty, without setae, 3–4μ thick; ascocarps thickly distributed on the colony, astomous at first, later perforating at the apex by disintegration of the weaker cells there, made up of a layer of dark brown polygonal cells, smooth, 80–100μ in diameter; ascocarpic setae at the summit only, surrounding the pore and oriented toward the leaf surface, 150–200μ long; asci numerous, separated by a thin, hyaline, septate, soon breaking tissue of parenchymatous cells which is attached, above and below, to the inner wall of the ascocarp, clavate, thick-walled, tunicate at the upper portion, sessile or very short pedicellate, 8-spored, 46–50 × 8–11μ; spores mostly biseriate, sometimes triseriate, two-celled, slightly constricted, greenish to light yellow, 9–12 × 2.5—4μ.

TYPE SPECIMEN: In Curtis Herbarium No. *1355*.
DISTRIBUTION: United States (South Carolina to Florida), Bermuda.
MATERIAL EXAMINED: On *Baccharis halamifolia* L.

Curtis Herbarium No. *1355 (Co-type)*; Roland Thaxter, No. *2474* and *3831*, Daytona, Fla., Jan. 1898; Anastasio Island, St. Augustine, Fla.; Collected by E. A. Rau, 1885 (In Herbarium N. Y. Bot. Garden.)

On *Baccharis glomerolifera* Pers.

Plants of the Gulf States, Collected by S. M. Tracy, Manatee, Fla. No. *7279;* R. Thaxter, Daytona, Fla. 1898 (In Herb. N. Y. Bot. Garden); G. Nelson, Sebastián, Fla. (In Herb. N. Y. Bot. Garden.)

2. **Lasiostemma distans** (Rehm) comb. nov.
Asterdium distans Rehm, Hedwigia **40**: 157. 1901.
Asterella trichodea Rehm. Ibid. 159.
Capnodinula trichodea (Rehm) Speg. Physis **4**: 288. 1918.
Dimeriella caracaensis Maubl. Bull. Soc. Myc. France **36**: 34 1920.

Spots none, colonies epiphyllous, round, often confluent but always regular, velutinous, brownish-black, dull, 3–7 mm. across; mycelium superficial, scanty, yellowish, pellucid, septate, branched, about 3 μ thick; fruiting bodies scattered black dull, perforated by a pore which is sorrounded by long, septate, dark brown, setae measuring 200–300μ long, 114μ in diameter; asci ellipsoid, thick tunicate, short pedicellate, separated by a similar tissue as above, two-celled, slightly constricted, upper cell a little wider than the lower, hyaline or dilute brownish, 13–17 × 5–6μ.

TYPE SPECIMEN: H. Patzche No. *2127*.
DISTRIBUTION: South America (Brazil and Ecuador).
ILLUSTRATIONS: G. Arnaud, Les Asterines I. Pl. III as *D. melioloides* B. & C.

MATERIAL EXAMINED: On Composite.
H. Patzxche No. *2127 (type).* Ule Fungi Amazonici No. *1857.*
On *Baccharis genitillioides* Pers., Theissen Decades Braziliensis No. *238.*
On *Baccharis* sp., A. Maublanc, Fungi Brasiliensis No. *327,* Caraca, Minas Geraes, Sept. 18, 1913.

This species, though occuring on the same host genus as the above species, differs from it in the character of the colonies, the length of the setae and its geographic distribution.

3. **Lasiostemma coronata** (Speg.) comb. nov.
Asteridium coronatum Speg., Anal. Cien. Argentina **26**:18. 1888.
Dimerosporium Puiggarii Speg., Bol. Acad. Nac. Cien. Córdoba **11**:485. 1889.
Asterella Conyzae Pat., Bull. Soc. Myc. France **8**: 127. 1892.
Dimerosporium annulatum Rehm, Hedwigia **35**: 53. 1896.
Asterella longiseta Starb., Bih. K. Svensk. Vet. Akad. Handl. Stockholm **253**: 25. 1899.
Dimeriella horridula Syd., Ann. Myc. **7**: 352. 1909.
Dimeriella longiseta (Starb.) Th., Broteria. **9**: 12. 1910.
Dimeriella Conyzae (Pat.) Th., Ann. Myc. **10**: 183. 1912.
Dimeriella erigeronicola Stev., Trans. Illinois Acad. Sci. **10**: 166. 1917.
Dimeriella claviseta Doidge. Trans. Roy. Soc. South Africa **56**: 717. 1917.
Pseudperisporium erigeronicolum (Stev.) Toro, Sci. Surv. Porto Rico **8**^{1}: 41. 1926.
Chaetostigme erigeronicola (Stev.) Illinois Biol. Monog. **11**^{2}: 169. 1927.
Chaetostigme horridula (Syd.) Clements & Shear, Genera *Fungi* **1930**: 250.

Colonies epiphyllous, forming small, round, hardly distinguishable or larger, concentric, colonies 1–4 mm. in diameter; crusts black, dull, widely scattered; mycelium sinous, septate, yellowish-pellucid, hyaline at the extremities, sometimes anastomosing, 1.5–2.5μ wide; ascocarps black-brown, numerous in each colony, globose, perforated at the apex, composed by one layer of polygonal, parenchymatous cells, 60–115μ in diameter, adorned at the base or lower middle part by 9–15, septate, long clavate, sometimes uncinate, truncate or lobed, setae about 200μ long 2–7μ wide; asci cylindric-clavate, apex tunicate, numerous and separated from each other by long, septate, hyaline, thin strands of pseudoparenchymatous tissue which soon disintegrate,

8-spored; sessile or short pedicellate, 35–55 × 10–20μ; spores conglobate or biseriate, 2-celled, slightly constricted, hyaline at first, yellowish with age, 8–15 × 3–7μ.

The distinguishing character of this species is the arrangement of the individual colonies in concentric rings. Its spore character is very variable, sometimes being definitely two-celled, while others appear as if three septate by the formation of a false septum at one of the cells, thus dividing the spore into three unequal cells. Sometimes the content is granular. The mature spores are yellowish, though this character is not constant. The variability of this species is better expressed in the comments of Theissen (25) "... In formis modo relatis varii coloris gradus hyalinis flavi viriduli et fusci exhibentur et saepe quidem in aedem matrice".

TYPE SPECIES: B. Balansa Fungi Paraguayensis No. *3925*.
ILLUSTRATIONS: Bih. t. Kongl. Sevenska Vet. Akad. Handl. 25, pl. I fig. 43. Trans. Roy. Soc. South Africa 56: pl. LVII figs. a, b, c.
DISTRIBUTION: South America, South Africa, West Indies.
MATERIAL EXAMINED: On Composite.

B. Balansa, Fungi Paraguayensis, Paraguari, No. *3925*, Aug. 1883. No. *3582*, Caayazu.

On *Bacharis* sp.

Theissen Decades Brasiliensis No. *722*, Sao Paulo, Río Grande do Sul.

On *Leptilon pusillum* (Nutt.) Britton.

Cornell University Explorations of Porto Rico Whetzel, Kern & Toro No. *2637*, Ciales, P. R., July 20, 1924. Fungi of Venezuela, Kern & Toro No. *1709*, Ocumare de la Costa.

On *Senecio* sp.

Puiggari No. *2586*. Apiaphy, San Pablo, Brazil, April 1888.

On *Leptilon bonariensis* (L.) Small.

F. L. Stevens, Puerto Rico Fungi No. *189*.

H. Sydow, Fungi Venezuelani, No. *249* Pto. La Cruz, Jan. 16, 1928.

F. L. Stevens, Fungi British Guiana No. *204*, Fumatumari, July 11, 1922.

On *Leptilon chinense* (Jacq.) Britton.

F. L. Stevens, Puerto Rican Fungi No. *2048*, Quebradillas, P. R.

4. **Lasiostemma cordiicola** (P. Henn.) comb. nov.
Dimerosporium cordiicolum P. Henn., Hedwigia **43**: 355. 1904.
Dimerosporium cordiae P. Henn., Hedwigia **48**: 4. 1908.

Dimeriella cordiae (P. Henn.) Th., Beih. Bot. Cent. **26**: 67. 1912.
Dimerium Stevensii Garman, Mycologia **7**: 337. 1915.
Chaetostigme cordiae (P. Henn.) Stev. Illinois Biol. Monog. **11**: 169. 1927.

Colonies epiphyllous, indistinct, widely spreading mycelium branched, wavy, septate, brown-pellucid, forming a faint pellicle over the leaf surface, without setae or hyphopodia, 2–3μ thick; ascocarps scattered over the mycelium round or somewhat egg-shaped, at the apex with a round pore about 18μ in diameter, dark brown, 60–70μ in diameter; beset at the center of the lower portion by short, septate, entire or toothed, numerous setae 40–50μ long; asci clavate, thick-walled, intersperse by thin, septate, hyaline tissue which soon disintegrates resembling paraphyses, tunicate above, somewhat saccate at the base, sessile or short pedicellate, 8-spored, 30–45 × 14–18μ; spores biseriate or triseriate, somewhat ellipsoid, 2-celled, slightly constricted, hyaline at first, light brown with age, 10–15 × 5–7μ.

Though *Dimeriella Cordiae* (P. Henn.) Th. has been generally accepted by all workers as the proper name for this species, a comparison of the type specimens of *cordiicolum* and *cordiae*, showed that they are indentical, the former name having priority. However, the material on which the species was based is immature and that accounts for the differences encountered by the author of both species. *D. Cordiae* was selected by Theissen and Sydow (l. c.) as the new-type of *Dimeriella* but on the assumption that it contains hyaline spores. Subsequent studies of abundant material from different localities has revealed that the spores are brown. Garman's placement of the Porto Rican material under *Dimerium* illustrates this fact. In its general appearance the species resemble a *Colcroa* or *Gibbera* with superficial mycelium. However, its superficiality and lack of conidial form makes it unlike any of these genera.

TYPE SPECIMENS: E. Ule's Herbarium Brasiliensis No. *2950*.
ILLUSTRATIONS: Illinois Biol. Monog. 11, pl. III, fig. 18; Monog. Univ. of Porto Rico, series B. No. 2, pl. 27, fig. 1–2.
MATERIAL EXAMINED: On *Cordia* sp.

Ule's Herb. Brasilensis No. *2950*, Jurua, Est. Amazonas, Sept. 1901. Steven's Trinidad Fungi, St. Clair No. *892*, Oct. 15, 1912; Port of Spain, No. *863*, Oct. 14, 1912. Plants of Costa Rica, Paul C. Standley, El Limón, No. *48380*, Feb. 20, 1926. Fungi Brasilensis, Putemans No. *640*, Sao Paulo, Feb. 1903. Explorations of Venezuela, Kern & Toro No. *1835*, Monai, May 1934. Chardón & Toro No. *502* and *495*. Road from Turmero, July 9, 1932.

On *Cordia cylindrostachya* R. & S.

Fungi Venezuelani, H. Sydow No. *802*, Antimano, Dec. 12, 1927. Chardón and Toro Explorations of Venezuela No. 754, Los Teques, July 29, 1932. Cornell University, Explorations of Puerto Rico, Whetzel and Olive *611*, Yauco, March 30, 1916.

On *Cordia corymbosa* (L.) G. Don

Porto Rico Fungi, Stevens, No. *931*, College Grounds, Mayagüez; Fungi Venezuelani, H. Sydow, No. *41*, Catia, Dec. 16, 1927. Explorations of Colombia, Chardón, No. *425*, near Buga, June 4, 1929. Herbarium, C. E. Chardón, Whetzel & Olive's Fungi of Puerto Rico, No. 6637, Mayagüez, March 13, 1916; Coamo, August 24, 1920, collected by C. E. Chardón, No. *855*.

On *Cordia microscephalla* H. B. K.

Fungi Venezuelani, H. Sydow, No. *197*, El Limón, Pto. La Cruz, Jan. 9, 1928.

On *Cordia ferruginea* (L.) R. & S.

Explorations of Colombia, Chardón No. *265*, Jamundi, May 15, 1929.

5. **Lasiostemma disseminata** (Sydow) comb. nov.
Dimeriella disseminata Sydow, Ann. Myc. **28**: 66. 1930.

Colonies hypophyllous, forming no spots; mycelium thin, covering large areas of the leaf surface, septate, branched, light brown, 2–4µ thick; fruit bodies widely distributed over the mycelium, round when young, perforated at the apex at maturity and then conic, 75–130µ wide, about 150µ high, adorned at the base with radiating hypha which form a subiculum while from about the center there are one or two rows of long, septate, obtuse setae reaching about 150µ long; asci numerous, clavate, thickly tunicate, sessile or short stipitate, with separating pseudo-parenchymatous tissue, 8-spored 40–65 × 12–18µ; spores sub-biseriate, fusoid, straight or slightly curved, ends round, hyaline at first, olivaceous with age, two-celled, constricted, 14–20 × 5–8.

Material Examined: On *Lasiacis sorghoidea* (Desv.) Hitch y Chase., Fungi Venezuelani, H. Sydow, No. *260b (Type)*, El Limón, Pto. La Cruz, Jan. 16, 1928.

6. **Lasiostemma maculosa** (Ellis) comb. nov.
Venturia maculosa Ellis in N. Am. Fung. No. 200.
Meliola maculosa Ellis, Bull. Torrey Bot. Club. **8**: 91. 1881.
Dimerosporium Ellisii Sacc., Syll. Fung. **1**:53. 1882.
Dimeriella maculosa (Ell.) Th., Beih. Bot. Cent. **29**: 37. 1912.

Colonies hypophyllous, numerous, dull black, frequently anastomosing, 8–10 mm., round or irregular; mycelium brown-pellucid, septate, straight, about 3μ wide; ascocarps globose, black, astomous or perforated at the apex, 100–120μ in diameter, setae hair-like, sorrounding the upper portion of fruit bodies, rather thick, dark brown, acute, somewhat twisted or straight, 100–160μ long, 8–10μ wide; asci cylindrical, thick walled, intersperse by hyaline, pseudoparenchymatous tissue, short pedicellate, tunicate in the upper portion, 40–50 × 10–14μ; spores inordinate, light olivaceous, two-celled, slightly constricted, cells unequal, 10–12 × 5–6.

MATERIAL EXAMINED: On *Andromeda* sp.

Ellis North American Fungi No. *200 (Type)*, New Field, N. J. 1878.

DISTRIBUTION: United States; (New Jersey, Mississippi, Michigan).

7. **Lasiostemma Gnaphali** (P. Henn.) comb. nov.
Dimerosporium Gnaphali P. Henn. Hedwigia **41**: 297.
Asterina microtheca Pat. Soc. Myc. France **18**: 301. 1902.

Spots amphigenous, brown, irregular, extending beyond the individual colonies, usually confluent; colonies superficial, round or irregular, 2–4mm. in diameter; mycelium thin, brown pellucid, septate, straight, 3μ wide; ascocarps gregarious, black, small, round, usually perforated at the apex, 70–100μ in diameter, setae-radiating from the base, septate, darker than the mycelium, tips obtuse, 80–123μ long; asci clavate, sessile or short pedicellate, tunicate above, thick-walled throughout, 8-spored, 20–30 × 8–12μ; spores sub-biseriate, 2-celled, fusoid, or clavate, apex acute, slightly constricted, olivaceous, 6–8 × 3μ.

TYPE SPECIES: Putteman's Fungi Sao Paulensis No. *458.*

DISTRIBUTION: South America (Brasil).

MATERIAL EXAMINED: On *Gnaphali* sp.

Fungi Sao Paulensis, Putteman No. *458,* Pedra Branca, Nov **1901.**

On *Leucopsis Tweediae* Baker

Patouillard's Herbarium, No. number, Leg. Glaziou, Brasil.

2. NEOHOEHNELIA Th. & Syd. Ann. Myc. **15**: 476. 1917.

This genus is incorporated by the authors among the Capnodiaceae. Its general character and relationships will not be discussed here for such procedure would involve a consideration of the affinities of *Dimerosporina* v. Höhn., *Henningsiomyces* v. Hôhn. *Dystychnis* Clem., and other Capnodiaceous genera. Such discussion is outside of the scope of this paper. Mention is only made because the well known

and widely distributed *Dimeriella Olyrae* is a synonym of ***Meliola oligotricha*** Mont, type of the genus. We will refer again to this genus when considering the Capnodiaceae.

8. **Neohoehniela oligotricha** (Mont.) Th. & Syd., Ann. Myc. **15**: 576. 1917.
   Meliola oligotricha Mont., Syll. Crypt. **1856**: 254.
   Dimerosporium oligotrichum (Mont.) Sacc. Syll. Fung. **1**: 54. 1882.
   Dimerium oligotrichum (Mont.) Sacc. Syll. Fung. **17**: 537. 1905.
   Parodiella setulosa P. Henn. Hedwigia **43**: 357. 1905.
   Henningsomyces oligotrichum (Mont.) v. Höhn., Sitz, K. Akad. Wis. Wien. **119**: 460. 1910.
   Pseudoparodia setulosa (P. Henn.) Th. & Syd. Ann. Myc. **15**: 139. 1917.
   Dimerosporina setulosa (P. Henn.) Th. & Syd., Ann. Myc. **15**: 167. 1917.
   Asterina fumagina Dearn & Barth., Mycologia **9**: 349. 1917.
   Dimeriella fumagina (Dearn. & Barth.) Stev. in Stevenson, Journ. Dept. Agric. Porto Rico **2**: 36. 1918.
   Dimeriella Olyrae Stevens, Trans. Illinois Acad. Sci. **10**: 167. 1917.

Colonies epiphyllous, abundant, black dull, round, usually anastomosing, 1–3 mm. in diameter, mycelium dematioid in the vicinity of the fruiting bodies, straight toward the ends, septate, crooked, 3–4μ thick; ascocarps numerous, black, rugulose, astomous with 1–3 straight, septate, obtuse setae; mycelial setae also present, 200–300μ long; asci 8-spored, clavate, tunicate, 50–70 × 25–30μ; spores inordinate, septate, hyaline at first, light yellowish with age, 15–18 × 7–8μ.

TYPE SPECIMEN: Fungi of Cayenne, Leprieur. No number.
ILLUSTRATION: Hedwigia **43**: 358. 1904.
MATERIAL EXAMINED: On *Olyra latifolia* L.
Herbarium of F. v. Höhnel slide collection; Ule Fungi Brasilensis No. *3308,* Tarapoto, Peru; Porto Rican Fungi, Bruce Fink No. *453,* Río Piedras, Nov. 30, 1915; No. *1265,* Dec. 23, 1915, Mayagüez.

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LITERATURE CITED

1. **Arnaud, G.** Les Astérinées. Ann. Ecole Nat. Agri. Montpellier **16**: 1–288. 1918.
2. ———— Etude sur les champignons parasites. Ann. Epiphytes **7**: 1–144. 1921.
3. ———— Les Astérinées IV. Ann. Sc. Nat. Bot. X serie **7**: 643–723. 1925.
4. **Bessey, E. A.** Text-book of Mycology. P. Blakiston & Sons, New York. 1935.
5. **Fitzpatrick, H. M.** Lectures in Mycology. Mimeograph, Cornell University. 1934
6. **Frey, C. N.** The Cytology and physiology of *Venturia inaequalis* (Cooke) Wint. Trans. Wisconsin Acad. Sci. **21**: 303–343. 1924.
7. **Graff, P. W.** The morphological and cytological development of *Meliola circinans*. Bull. Torrey Bot. Club. **59**: 241–266. 1932.
8. **Gwynne-Vaughan, Helen.** Fungi Cambridge Bot. Handbook **1922**: 232.
9. **Hohnel, Fr. v.** Fragmente zur Mykologie VIII. Sitz Akad. Wis. Wien **118**: 157. 1909.
10. ———— Ueber den Zusammenhang von *Meliola* mit den Microthyriaceen. Ber. Deut. Bot. Gess. **36**: 471–473. 1918.
11. ———— Ueber Bau Stellung und Nebenfruchte von *Lasiobotrys*. Ber. Deut. Bot. Gess. **37**: 103–107. 1919.
12. **Killian C.** Le dévelopment du *Stigmatea Robertiana* Fries. Rev. Gen. Bot. **34**: 577–588. 1922.
13. **Lindau, G.** Perisporiales in Engler und Prantl, Die Natürlichen Pflanzen familien **1**: 325–343. 1898.
14. **Miller J.** Biologic studies in the Sphaeriales I. Mycol. **20**: 187–212. 1928.
15. **Nannfeldt, J. A.** Studien über die Morphologie und Systematik dernicht — licheni-sierten inoperculaten Discomyceten. Nova Acta Reg. Soc. Sc. Upsala Ser. 4 8^2: 1–368. 1932.
16. **Petrak, F. & H. Sydow.** Kritisch-systematische Originaluntersuchungen über Pyrenomyzeten, Sphaeropsideen und Melanconieen. Ann. Mycol. **21**: 364. 1923.
17. ———— Uber die Gattung *Lasiobotrys* Kuntze. Ann. Myc. **25**: 336. 1927.
18. ———— Ueber Dimerosporium Manihotis P. Henn. Ann. Myc. **22**: 295. 1924.
19. ———— Ueber Englerula und die Englerulaceen. Ann. Myc. **26**: 385–413. 1928.
20. **Saccardo, P. A.** Sylloge Fungorum **1**: 56, 1882.

21. **Spegazzini, C.** Fungi aliquot Paulistani. Rev. Mus. La Plata **15**: 12. 1908.
22. **Sydow, H.** Beiträge z. Kenntnis d. Pilzflora Neo-Seelands I. Ann. Myc. **22**: 295. 1924.
24. **Theissen, J.** Zur Revision der Gattung Dimerosporium. Beih. Bot. Cent. **29**: 45–73. 1912.
25. ———— Perisporiales riograndenses. Broteria **9**: 5–44. 1910.
26. ———— Hemisphaeriales. Ann. Myc. **11**: 468–469. 1913.
27. ———— **& H. Sydow.** Synoptische Tafeln. Ann. Myc. **15**: 389–490. 1917.
28. **Weston, Wm. H.** Observations on Loramyces, an undescribed aquatic ascomycete. Mycologia **21**: 55–75, 1929.
29. **Woronichin, N. N.** Ueber die Capnodiales. Ann. Myc. **23**: 174–178. 1925.

NEW OR LITTLE—KNOWN SPECIES OF WEST INDIAN TIPULIDAE (DIPTERA) IV

By Charles P. Alexander *

The third part under the above title appeared in this Journal, vol. XXI, No. 4, October 1937. The present report is based almost entirely on extensive collections of crane-flies that were taken on various West Indian islands, chiefly by Mr. P. J. Darlington, Jr., and by Mr. Marston Bates, and are now preserved in the Museum of Comparative Zoölogy, Cambridge, Mass. The species that were taken on the higher mountains of Haiti and the Dominican Republic proved to be of especial interest and value.

In a preliminary section, I am discussing a small but very interesting collection of these flies that was taken in the island of Dominica, Lesser Antilles, by Mr. Walter H. Hodge, at the present time a student at the Gray Herbarium, Harvard University. The specimens in this latter series are preserved in my personal collection. I wish to express my sincere thanks and indebtedness to Messrs. Bates, Darlington and Hodge, and to Dr. Nathan Banks of the Museum of Comparative Zoölogy, for the privilege of studying this exceptionally interesting series of Tipulidae.

I. Tipulidae from the Island of Dominica

The species herewith recorded appear to be the first that have been taken in Dominica, although rather numerous species are known from St. Vincent. A most interesting general account of conditions in the island is given by Frederick A. Ober, *Camps in the Caribbees* (Edinburgh; David Douglas), pp. 1–366; 1880. Mr. Hodge, collector of the present material has supplied the following notes concerning the localities where the more interesting species were secured.

Morne Trois Pitons: A volcanic peak situated roughly in the center of the island and a peak which has at times been claimed to be higher than the generally accepted tallest peak, Morne Diablotin. According to Dr. Paul Griswold Howes, of Greenwich's Bruce Museum, Trois Pitons is 4,600 feet. The crane-flies were collected on one of the two lesser summits, altitude 4,500 feet, in typical wind-dwarfed, rain-swept cloud forest, the branches of the trees dripping

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with mosses and hepatics and laden with other epiphytes, particularly water-containing Bromeliads. Here the cane-flies (*Tanypremna hodgei* (sp. n.) occurred in dozens, many mating. The few I managed to pick up I had to stalk after they had alighted beneath the shelter of the leaves. During the summer months, part of the rainy season, the summits of all of Dominica's mountain peaks are almost continually enshrouded by rain clouds. Rainfall near the summits must exceed 300 inches per year.

Hatton Garden Trail: An old Carib footpath running through virgin tropical rain forest from Sylvania Estate, near Trois Pitons, to Hatton Garden Estate on the northeast (windward) coast. Crane-flies were secured by sweeping the vegetation along the Layou River near its source in the neighborhood of the old abandoned Riversdale estate. Altitude approximately 2,000 feet; rainfall about 200 inches. River bed rocky and boulder-filled. Stream turbulent.

Sylvania Estate: Near the base of Trois Pitons (west). Altitude 1,800 feet; rainfall between 175 and 200 inches. Surrounding forests can be called true "rain-forests".

Tanypremna (*Tanypremna*) hodgei sp. n.

General coloration of mesonotum dark brown; pleura medium brown, unmarked; halters relatively short, dark brown throughout; legs brownish black, passing into black on all tarsi; wings with a strong brown suffusion, cell *Sc* and the stigma darker brown; cell *1st* M_2 short and wide; abdominal tergites dull black, before mid-length ringed with yellow, the outer segments and hypopygium uniformly black; male hypopygium with the dististyle at base on outer margin produced into a powerful spine.

Male.—Length about 14–15 mm.; wing 11.5–12.5 mm.; antennae 1.4 mm.

Female.—Length about 17–19 mm.; wing 13–14 mm.; antennae 1.4 mm.

Frontal prolongation of head very short, reddish brown; palpi black. Antennae shorter than palpi; basal segments brownish yellow, the outer ones more darkened; basal flagellar segments enlarged, the outer ones linear, with long conspicuous verticils. Head reddish fulvous, variegated with darker on vertex, expecially across the anterior vertex as a more or less continuous band.

Pronotum yellowish brown. Mesonotal praescutum chiefly covered by four dark brown, subnitidous stripes, the intermediate pair separated by a capillary darker vitta, the posterior interspaces scarcely indicated; posterior sclerites of notum dark brown, the sides of

mediotergite a little paler. Pleura medium brown, unmarked. Halteres short, dark brown throughout. Legs with the coxae and trochanters pale brown; femora and tibiae brownish black, the tips somewhat more blackened; all tarsi black. Wings (Fig. 1) with a strong brown suffusion, cell *Sc* and the stigma darker brown; paler streaks in centers of some of the cells, especially in female; veins brownish black. Venation: Sc_1, free tip of Sc_2 and R_{1+2} all relatively close together at wing-margin, the distance between them less than vein R_{1+2} alone; cell *1st* M_2 short and wide, *m-cu* at near two-thirds its lower face; petiole of cell M_1 variable in length, but approximately equal to *m*.

Abdomen elongated; tergites ringed with yellow and dull black, the latter including more than the outer half of the segment, as well as a very narrow darkening at base, restricting the yellow to the outer portion of basal rings; outer segments and hypopygium uniformly black; sternites more yellowish, the posterior borders of the more basal segments broadly brown, passing into black on outer segments. In the female, the yellow color is more obscured and pruinose. Male hypopygium with the outer basal portion of dististyle (Fig. 10, *d*) produced into a strong blackened spine; beak of style on outer margin before apex with one or two small blackened pegs. Ovipositor with valves sclerotized, relatively slender.

Habitat.—Dominica.

Holotype, ♂, Morne Trois Pitons, altitude 4,500 feet, August 15, 1938 (*Hodge*). Allotopotype, ♀. Paratopotypes, ♂ ♂, 1 ♀.

Tanypremna (Tanypremna) hodgei is named in honor of Mr. Walter H. Hodge who collected this important series of Dominican Tipulidae. It is very different from the other species of the typical subgenus that have darkened tarsi, as *I. (I.) carbonipes* Alexander (Ecuador), *I. (I.) fuscitarsis* Alexander (Colombia), *T. (T.) kadeni* Alexander (Venezuela *T. (T.) invaripes* Alexander (Brazil), especially in the coloration of the thoracic notum and pleura, the venation, and the structure of the male hypopygium. The genus hitherto had not been detected in any of the West Indian islands, on the mainland extending from southwestern Mexico southward to southeastern Brazil.

Limonia *(Limonia)* **apicata dominicensis** subsp. n.

Male.—Length about 5 mm.; wing 5.5 mm.

Female.—Length about 7.5 mm.; wing 7 mm.

Characters as in typical *apicata* Alexander (ranging from northern Florida, subspecies *subapicata* Alexander, to Peru, subspecies *na-*

poensis Alexander), differing only in slight hypopygial characters. Male hypopygium with the gonapophyses (Fig. 13) very broadly expanded and compressed, before apex bearing a small spinous point.

Habitat.—Dominica.

Holotype, ♂, Layou River, on Hatton Garden Trail, altitude 2,000 feet, August 16, 1938 (Hodge). Allotype, ♀, Sylvania Estate, altitude 1,800 feet, August 29, 1938 (Hodge).

Limonia (Rhipidia) domestica (Osten Sacken).

Dominica: Marigot, July 1938 (Hodge). Lisdara Estate, altitude 1,800 feet, August 1937 (Hodge).

Limonia (Rhipidia) costalis (Williston).

Dominica: Sylvania Estate, altitude 1,800 feet, August 29, 1938 (Hodge).

Limonia (Geranomyia) cinereinota (Alexander).

Dominica: Layou River, on Hatton Garden Trail, altitude 2,000 feet, August 16, 1938 (Hodge). Hitherto from Greater Antilles; northern South America, south to Paraguay.

Limonia *(Geranomyia)* **dominicana** sp. n.

Mesonotal praescutum pale gray, with a broad, yellowish brown, median stripe, the lateral borders of the sclerite broadly dark brown; knobs of halteres dark brown; femora yellow, with a narrow brown subterminal ring; wings yellow, variegated with pale brown, the dark areas at origin of *Rs* and fork of *Sc* barely connected; *Sc* short, Sc_1 ending about opposite one-fourth the length of *Rs;* abdominal segments yellow, narrowly ringed caudally with brown; male hypopygium with the rostral prolongation of ventral dististyle short, with a powerful common tubercle bearing two unusually long curved spines; aedeagus at apex with two conspicuous lobes.

Male.—Length, excluding rostrum, about 7 mm.; wing 6.8 mm.; rostrum about 3 mm.

Rostrum and palpi black, the former elongate. Antennae with scape and pedicel black, flagellum pale brown; flagellar segments oval. Head dark gray, the anterior vertex and a central line back to occiput light gray.

Mesonotal praescutum pale gray, with a broad yellowish brown median stripe that is a little darker in front, on posterior half narrowly delimited by delicate dark margins; lateral praescutal borders broadly and conspicuously dark brown; scutellum and median region

of scutum pale testaceous, the scutal lobes darker, delimited internally by a narrow dark line; postnotum pale. Pleura yellow, variegated with brown, especially on dorsal portion. Halteres with stem pale yellow, knob dark brown. Legs with the coxae yellow, fore pair a trifle darker; trochanters yellow; femora obscure yellow, with a narrow, dark brown, subterminal ring, about equal in extent to the clear yellow apex; remainder of legs obscure yellow, the terminal tarsal segments a little darker. Wings yellow, the costal border more saturated; a conspicuous pale brown pattern, as follows: A series of five costal darkenings, the first at arculus, second at supernumerary crossvein in cell *Sc*, both small; third area larger; at origin of *Rs* and fork of *Sc*, barely interconnected and forming an irregular area; stigma relatively small; fifth darkening small, at end of vein R_3; cord and outer end of cell *1st* M_2 seamed with brown; small marginal dark clouds at ends of veins M_3 and M_4, with larger and more conspicuous ones on veins *Cu*, *1st A* and *2nd A*; veins yellow, slightly darker in the clouded areas. Venation: *Sc* relatively short, Sc_1 ending about opposite one-fourth the length of *Rs*, Sc_2 at its tip; cell *1st* M_2 about as long as vein M_{1+2} beyond it; *m-cu* at fork of *M*.

Abdominal segments yellow, narrowly ringed caudally with brown; hypopygium yellow brown. Male hypopygium with the caudal margin of tergite nearly truncate or very feebly emarginate. Ventral dististyle much more extensive than basistyle; rostral prolongation short and stout, more than one-half of its outer margin involved in a large tubercle that bears the two long spines; these latter borne at tip of tubercle, subequal in length, strongly curved, exceeding in length the dorsal dististyle; base of tubercle expanded proximad into a flange; apex of rostrum beyond tubercle very short, only about one-third the length of tubercle. Gonapophyses with mesal-apical lobe blackened, expanded, at apex narrowed into a very short decurved beak. Aedeagus short, at apex with two conspicuous lobes.

Habitat.—Dominica.

Holotype, ♂, Sylvania Estate, altitude 1,800 feet, August 30, 1938 (Hodge).

The most similar described species include *Limonia (Geranomyia) caruncwlata* Alexander and *L. (G.) deliciosa* Alexander, both of which are readily distinguished by the structure of the male hypopygium.

Limonia *(Geranomyia)* **microphaea** sp. n.

Size very small (wing, ♂, less than 5 mm.); general coloration brownish black, unmarked; rostrum elongate, about two-thirds the

length of body; halteres brownish black, the base of stem obscure yellow; wings strongly tinged with brown, stigma darker brown; *Sc* relatively short, Sc_1 ending about opposite one-forth to one-fifth the length of *Rs*; cell 2nd *A* narrow, especially on outer half; abdominal tergites brownish black, basal sternites obscure yellow; hypopygium uniformly blackened; male hypopygium with the ventral dististyle much more extensive than the basistyle; rostral prolongation long and slender, at base with a low common tubercle from the summit of which arise two straight spines of moderate length, these spines shorter than the prolongation; gonapophyses with mesal-apical lobe a short curved black spine.

Male.—Length, excluding rostrum, about 4 mm.; wing 4.8 mm.; rostrum about 2.8 mm.

Rostrum very long, about two-thirds the length of body, black, the distal third of paraglossae paling to brown. Antennae broken. Head dark.

Mesonotum almost uniformly dark brown to brownish black, the surface polished, the humeral region of praescutum a little brightened. Pleura dark brown, the ventral portion of sternopleurite paler. Halteres brownish black, the base of stem obscure yellow. Legs with coxae brownish yellow; trochanters yellow; remainder of legs broken. Wings strongly tinged with brown, cells *C* and *Sc* a trifle darker; stigma oval, darker brown; veins dark brown. Venation: *Sc* relatively short, Sc_1 ending about opposite one-fourth to one-fifth of *Rs*, Sc_2 at its tip; *Rs* relatively long, fully three times the arcuated basal section of R_{4+5}; cell *1st* M_2 nearly as long as vein M_{1+2} beyond it; *m-cu* shortly before fork of *M;* cell *2nd A* narrow, especially on outer half.

Abdominal tergites brownish black; basal sternites obscure yellow; hypopygium uniformly blackened. Male hypopygium (Fig. 15) with the caudal margin of tergite with a broad U-shaped notch, the lateral lobes broad. Dorsal dististyle only gently curved, the tip a slender spine. Ventral dististyle large and fleshy, much more extensive than basistyle; rostral prolongation long and slender, at base on outer face with a low common tubercle, from summit of which arise two relatively short, straight spines, these shorter than the prolongation distad of tubercle. Gonapopyses with mesal-apical lobe a short curved black spine, the tip acute.

Habitat.—Dominica.

Holotype, ♂, Layou River, on Hatton Garden, altitude 2,000 feet, **August 16, 1938** (Hodge).

Limonia (Geranomyia) microphaea is somewhat similar to *L. (G.) cerberus* Alexander and *L. (G.) fluxa* Alexander, differing especially in the small size, uniformly dark brown mesonotum, and structure of the male hypopygium.

Limonia (Geranomyia) plumbeipleura Alexander.

Dominica: Sylvania Estate, altitude 1,800 feet, August 28–30, 1938 (Hodge). Formerly known from northern South America and Trinidad.

Limonia *(Geranomyia)* **sylvania** sp. n.

Allied to *plumbeipleura;* size small (wing, ♂, under 6 mm.); mesonotum buffy brown, with three brown praescutal stripes; femora obscure yellow, with a narrow brown subterminal ring; wings yellow, patterned with brown, the dark area at origin of *Rs* also involving the fork of *Sc;* abdominal segments dimidiate, the bases darkened, the apices yellow; male hypopygium with the spines of the rostral prolongation of ventral dististyle arising from tubercles that are much shorter than the spines themselves; mesal-apical lobe of gonapophysis a short blackened horn.

Male.—Length, excluding rostrum, about 4.6–5 mm.; wing 5.4–5.8 mm.; rostrum about 2 mm.

Rostrum black, relatively short. Antennae black throughout. Head black, the median region of vertex lined with light gray.

Mesonotum obscure buffy brown, with three distinct but somewhat poorly delimited brown stripes; scutum buffy brown, the lobes variegated with darker brown; posterior sclerites of notum chiefly darkened. Pleura with propleura obscure yellow; dorsal mesopleura and pleurotergite weakly darkened, the sternopleurite and meron yellow. Halteres obscure yellow, the base of stem a little brighter. Legs with the coxae and trochanters yellow; femora obscure yellow, with a narrow brown subterminal ring, the yellow apex beyond slightly wider; in cases, the femora are darker, more brownish yellow, and the subterminal dark ring is preceded by a narrow, clearer yellow annulus; tibiae and tarsi yellow, the outer tarsal segments darkened. Wings yellow, more saturated in the costal and prearcular fields, the apex, in cases, weakly darkened; a sparse brown pattern, including four subcostal areas that are more restricted than the interspaces; first area above arculus, tending to become evanescent; second area at supernumerary crossvein in cell *Sc;* third area large, irregular in outline, common to the origin of *Rs* and fork of *Sc;* fourth area largest, at stigma; narrower brown seams along cord, outer end of

cell *1st* M_2 and on distal portion of vein *2nd A;* veins yellow, darker in the infuscated areas. Venation: *Sc* relatively short, Sc_1 ending a short distance beyond origin of *Rs,* at about opposite one-fifth the length of this vein; *m-cu* at fork of *M.*

Abdomen more or less dimidiate, the bases of the segments narrowly darkened, the apices more extensively yellow; subterminal segments uniformly darkened; hypopygium yellow. Male hypopygium (Fig. 16) with the caudal margin of tergite broadly and conspicuously emarginate, the margins of the lobes broadly thickened and sclerotized; tergal setae coarser and more sparse than in *plumbeipleura.* Dorsal dististyle a curved sickle. Ventral dististyle large and fleshy, the rostral prolongation and spines much as in *plumbeipleura;* rostrum nearly parallel-sided, scarcely expanded outwardly; spines equal in size, the tubercle of the lower or more cephalic spine shorter, less than half the spine; both tubercles much shorter than the spines they bear, the outer being about two-thirds its spine. Gonapophyses with mesal-apical lobe appearing as a short blackened horn.

Habitat.—Dominica.

Holotype, ♂, Sylvania Estate, altitude 1,800 feet, August 28, 1938 (Hodge). Paratopotype, ♂.

Although allied tó *Limonia (Geranomyia) plumbeipleura* Alexander (Dominica and Trinidad; northern South America) and to *L. (G.) marthae* Alexander (Mt. Santa Marta, Colombia), the present fly is distinct in the characters listed in the diagnosis. The size and the general structure of the male hypopygium is more as in *marthae* but the coloration of the legs and details of the hypopygium in the latter, especially the very large ventral dististyle and its rostral spines, indicate a distinct species. All three forms constitute a group of closely interrelated flies.

Limonia (Geranomyia) tibialis (Loew).

Dominica: Sylvania Estate, altitude 1,800 feet, August 30, 1938 (Hodge).

Polymera *(Polymera)* **albitarsis dominicae** subsp. n.

Male.—Length about 4.5 mm.; wing 5.2 mm.; antennae about 6 mm.

Differs from typical *albitaris* Williston (St. Vincent), as follows: Size small. Mesonotum uniformly dark brown, only the humeral region and pretergites restrictedly obscure yellow. Pleura chiefly

covered by a very broad, black stripe, only the stenopleurite and ventral meron abruptly yellow. Legs with fore coxae blackened on basal two-thirds, the apex and remaining coxae light yellow; femora brown, passing into dark brown, the tips abruptly whitened; tibiae dark brown; outer tarsal segments whitened, in degree less than in typical *albitarsis*, the proximal half of the second tarsal segment of posterior leg darkened; in *albitarsis*, on the posterior legs, only the basitarsi are darkened. Wings very strongly suffused with brown; veins darker. Venation: Sc short, Sc_1 ending opposite fork of the short Rs; R_{2+3+4} long, nearly straight, fully as long as Rs and nearly twice R_{2+3}; R_{1+2} and R_{2+3} subequal.

Habitat.—Dominica.

Holotype, ♂, Sylvania Estate, altitude 1,800 feet, August 30, 1938 (Hodge).

Rhabdomastix fumipennis sp. n.

General coloration brownish black, the thorax unpatterned; antennae black; halteres and legs brownish black; wings with a strong brown suffusion; stigma ill-defined, very slightly darker than the ground; Rs approximately twice R_{2+3+4}; abdomen black.

Female.—Length about 5.5–6.5 mm.; wing 4.5–5 mm.

Rostrum and palpi brownish black. Antennae black throughout, of moderate length (female), if bent backward scarcely attaining the wing-root; flagellar segments subcylindrical. Head blackish.

Thorax uniformly brownish black, without markings. Halteres brownish black, the extreme base of stem pale. Legs with the coxae brownish black; trochanters testaceous; remainder of legs brownish black, the subterminal tarsal segments a little paler. Wings (Fig. 9) broad, with a strong brown suffusion; stigma ill-defined, very slightly darker brown than the ground; veins brown. Wing-veins chiefly naked; a series of trichia on outer ends of veins R_5, M_{1+2} and M_3; in cases, a single or very sparse trichia on M_4 and distal section of Cu_1. Venation: Rs considerably longer than in *parvula*, a little more than twice R_{2+3+4}; R_4 slihtly variable in length, subequal to or shorter than R_{2+3+4}.

Abdomen black. Valves of ovipositor, especially the cerci, elongate and very slender.

Habitat.—Dominica.

Holotype, ♂, Sylvania Estate, altitude 1,800 feet, August 29, 1938 (Hodge). Paratopotypes, 7 ♀♀.

Rhabdomastix fumipennis seems undoubtedly to be closed to *R. parvula* Alexander (*parva* Alexander, preoccupied), which belongs to the subgenus *Sacandaga* Alexander. In the absence of the male sex of the present fly, it seems inadvisable to refer it to a given subgenus since the antennae are short in the females in both of the regional subgenera; the males of *Rhabdomastix* Skuse, s. s., have the antennae much longer than the body, of *Sacandaga,* short as in the females. From *parvula,* the present fly differs most evidently in the broad wings with the venational details distinct, notably the long *Rs.*

Erioptera (Mesocyphona) caloptera Say

Dominica: Sylvania Estate, altitude 1,800 feet, August 29, 1938 (Hodge).

Toxorhina *(Toxorhina)* **fumipennis** sp. n.

General coloration of mesonotum dark brown, the lateral borders of praescutum broadly buffy gray; halteres and legs dark brown; wings with a strong brown suffusion, the veins darker; veins M_{3+4} and M_4 subequal; *m-cu* about one-third its length before fork of *M.*

Female.—Length, excluding rostrum, about 7 mm.; wing 5.2 mm.

Rostrum black, its apex broken. Head dark gray.

Cervical region and pronotum blackened. Mesonotal praescutum with disk brown, the lateral margins broadly buffy gray; posterior sclerites of notum dark, sparsely pruinose. Pleura with central portion chiefly infuscated, paler dorsally and ventrally. Halteres dark brown. Legs dark brown. Wings with a strong brown suffusion, unpatterned; veins darker than the ground. Venation: Sc_1 ending opposite origin of *Rs*, Sc_2 near its tip; basal section of M_{1+2} about two-thirds the second; M_{3+4} subequal to M_4 alone; *m-cu* about one-third its length before fork of *M.*

Abdominal tergites brownish black, sparsely pruinose; sternites paler.

Habitat.—Dominica.

Holotype, ♂, Sylvania Estate, altitude 1,800 feet, August 29, 1938 (Hodge).

The strongly infumed wings of the present species readily distinguish it from all other members of the genus so far described in the Neotropical fauna.

II. Tipulidae from the Greater Antillean Islands. Descriptions of new species and records of distribution from Cuba, Hispaniola, Jamaica and Puerto Rico.

Tipula darlingtoniana sp. n.

Size large (wing, ♂, over 25 mm.); mesonotum buffy, with four entire brown stripes, the interspaces with brown setigerous punctures; antennae yellow; legs with femora obscure brownish yellow, the tips blackened; wings whitish subhyaline, patterned with various shades of brown; *Rs* long, about three times *m-cu;* abdominal tergites buffy, quadrivittate with brown; cerci long, slender, straight.

Female.—Length about 31 mm.; wing 26 mm.

Frontal prolongation of head brownish gray above, brown on sides and beneath; nasus long and slender; palpi black, the apices of the intermediate segments narrowly yellow. Antennae yellow; first flagellar segment longer than the scape; verticils of intermediate segments exceeding the segments in length. Head grayish brown, with a narrow, dark brown, median vitta on posterior vertex; vertical tubercle relatively low.

Pronotum buffy, with three brown areas, the interspaces with brown setigerous punctures. Mesonotal praescutum buffy, with four entire dark brown stripes, the intermediate pair contiguous or narrowly confluent at ends, the median portion a little infuscated and lined centrally with darker, humera region of praescutum extensively dark brown; interspaces with conspicuous brown setigerous punctures; scutal lobes brownish gray, narrowly darker brown on mesal edge; median region of praescutum gray, with a capillary darker vitta; scutellum whitish gray, with a median brown vitta, parascutella dark; mediotergite gray, the central fourth whitish gray, bordered sublaterally by dark brown. Pleura brownish gray, clearer gray on ventral sclerites, sparsely variegated with brown on dorsal anepisternum and sternopleurite, and, especially, on the pleurotergite. Halteres with stem yellow, knob infuscated. Legs with the coxae gray, with brown punctures; trochanters obscure yellow; femora obscure brownish yellow, the tips rather narrowly blackened; tibiae obscure yellow, the tips passing into black; first and second tarsal segments obscure yellow, the tips darkened; remainder of tarsi black. Wings whitish subhyaline, conspicuously patterned with various shades of brown; prearcular field chiefly darkened, its outer end white; cell *C* uniformly brown except at outer end; cell *Sc* brownish yellow, with four major areas that extend into cell *R,* these

pale brown, bordered posteriorly by darker brown; outer radial field pale brown, bordered behind by a dark brown seam on outer two-thirds of vein R_{4+5}; basal two-thirds and outer end of cell *M* brown, the latter area paler, the cubital veins narrowly bordered by dark brown; outer portions of Anal cells pale brown; cell *Cu* and basal third of cell *1st* A washed with darker brown; restricted darker brown seams at outer end of cell *1st* M_{1+2}, *m-cu* and veins at base of cell *1st* M_2, and on vein *2nd A;* veins brown, a little paler in the ground areas. Venation: Distal half of vein R_{1+2} pale but preserved; *Rs* very long, about three times as long as *m-cu;* petiole of cell M_1 longer than *m*; basal section M_4 erect, exceeding M_{3+4}.

Abdominal tergites with the ground color buffy, variegated by two submedian dark stripes that are separated by a capillary median ground vitta; additional sublateral brown stripes, the interspaces with brown setigerous punctures; sternites chiefly dark brown, variegated by buffy. Ovipositor with long slender straight cerci; hypovalvae stouter.

Habitat.—Dominican Republic.

Holotype, ♂, Valle Nuevo, southeast of Constanza, altitude about 7,000 feet, August 1938 (Darlington).

I take very great pleasure in naming this striking and distinct fly in honor of the collector, Dr. P. J. Darlington, Jr., who has added so materially to our knowledge of the Tipulidae of Hispaniola. The species appears to belong to the *glaphyroptera* group of the genus, including a vast aggregation of South and Middle American forms, but not previously known from the West Indian islands. It is amply distinct from all other known species, especially in the coloration of the antennae, mesonotum, legs and wings.

Tipula (Yamatotipula) ludoviciana Alexander.

Cuba: Santiago de las Vegas, March 31, 1931 (A. Otero); April 20, 1931 (A. Cremata).

Nephrotoma circumscripta (Loew).

Cuba: Pico Turquino, Oriente altitude 5,000 feet, June 1936 (Julián Acuna).

Nephrotoma glabricristata sp. n.

Allied to *ferruginea;* basal three antennal segments yellow, the succeeding segments varying from uniformly black to weakly bicolorous; mesonotal praescutum yellow with three more nacreous stripes that are very narrowly bordered in part by dark brown;

mediotergite with a brown central stripe on anterior half; wings narrow, with a faint brown tinge, the stigma and costal border darker; wing-tip and seams along veins darkened; a few macrotrichia in outer end of cell R_3; abdomen orange, sparsely patterned with darker; male hypopygium with the dorsal crest of the inner dististyle high and entirely glabrous.

Male.—Length about 10 mm.; wing 9.5–10 mm.; antennae about 3.3 mm.

Female.—Length about 15 mm.; wing 11–11.5 mm.

Frontal prolongation of head polished yellow; nasus distinct; palpi yellow, the terminal segment a little darker. Antennae relatively short; basal three segments yellow, succeeding segments varying from uniform black to weakly bicolored, with the basal enlargement of the segment blackened, the apex paler (this latter condition in holotype); flagellar segments rather strongly incised. Head orange; occipital brand of moderate size, elongate oval, with the anterior end pointed, poorly defined.

Pronotum darkened laterally, clear light yellow medially above. Mesonotal praescutum yellow, with three more nacreous stripes that are very narrowly bordered by dark brown; on the lateral stripes this border is restricted to inner margin; lateral stripes straight, without clearly defined marginal marking opposite anterior end; scutum yellow, each lobe entirely traversed by posterior extensions of the lateral praescutal stripes, these not margined with darker; scutellum darkened, parascutella pale; mediotergite yellow, with a brown central stripe that is narrowed or obliterated on posterior half, posterior border of sclerite narrowly darkened. Pleura yellow, variegated with reddish brown, especially on propleura and on ventral anepisternum, sternopleurite, meron and pleurotergite. Halteres with stem obscure yellow, knob infuscated. Legs with the coxae reddish yellow; trochanters yellow; femora yellow, the tips very narrowly blackened; tibiae pale yellowish brown, passing into dark brown; tarsi black. Wings narrow, with a faint brown tinge; cell *Sc* and stigma brown, cell *C* and prearcular field more yellowish brown; wing-tip and very narrow seams along cord brown; a brown seam along vein *Cu;* veins dark brown, narrowly and vaguely seamed with brown. A few macrotrichia in outer end of cell R_5, with a few others at proximal end of stigma. Venation: Sc_2 ending opposite origin of the short oblique *Rs*, the latter in virtual alignment with R_{4+5}; cell M_1 narrowly sessile.

Abdomen orange, both tergites and sternites with a faint dusky median spot shortly before apex; hypopygium orange. Male hypopygium of the general type of *ferruginea;* inner dististyle with the dorsal crest unusually high and entirely glabrous; in *ferruginea,* the entire margin is provided with abundant short setae.

Habitat.—Cuba, Hispaniola.

Holotype, ♂, Loma del Gato, Sierra del Cobre, Oriente, Cuba, altitude about 3,000 feet, July 3–7, 1936 (Darlington). Allotopotype, ♀, Buenos Aires, Santa Clara, Cuba, July 19, 1932 (Bates & Fairchild). Paratopotype, ♂; paratypes, 1 ♂, 2 ♀♀, with allotype, July 19–20, 1932; ♂ ♀, Kenskoff, near Port-au-Prince, Haiti, altitude 4,000–6,000 feet, September 2, 1934 (Darlington); La Visite and vicinity, La Selle Range, Haiti, altitude 5,000–7,000 feet, September 16–23, 1934 (Bates); Loma Rucilla, Dominican Republic, altitude 5,000–10,000 feet, June 8, 1938 (Darlington).

Nephrotoma glabricristata is closest to *N. ferruginea* (Fabricius) and allies, especially to the southern Nearctic *N. ferruginea suturalis* (Loew). It differs especially in the coloration, narrow wings, and structure of the male hypopygium, as above described. I had earlier (Journ. Dept. Agr. Puerto Rico, 16: 378; 1932) recorded this species as a variety of *ferruginea* but with the present abundant material it appears to be quite distinct. In the Hispaniolan material, there is a slight modification of the praescutal pattern as above described. The margins of the central praescutal stripe and the mesal edge of each lateral stripe in cases with anterior ends outcurved towards margin but entirely polished and not differentiated in color from remainder of stripe.

Megistocera longipennis (Macquart).

Cuba: Santiago de las Vegas, May 22, 1931, October 3, 1929 (Otero); July 12, 1930 (Bruner).

Brachypremna unicolor Osten Sacken.

Cuba: San Blas, Santa Clara, Trinidad Mountains, altitude 700 feet, July 26; December 23, 1931 (Rowe).

Puerto Rico: One ♂, without further data, ex Winthem Collection in the Vienna Museum.

Dolichopeza (Megistomastix) devexa Alexander.

Cuba: North side of the Pico Turquino, Sierra Maestra, Oriente, altitude 4,500–6,000 feet, June 18–20, 1936 (Darlington).

Dolichopeza *(Megistomastix)* **darlingtoni** sp. n.

General coloration dark brown, the praescutum more reddish brown; antennae (male) short, less than one-half the length of body, verticils short; legs black, the femoral bases narrowly yellow; wings strongly darkened, the stigma dark brown; abundant macrotrichia in cells of outer three-fourths of wing; abdominal segments weakly bicolored, yellowish brown, the incisures narrowly blackened; male hypopygium with eighth sternite produced into a long median lobe that terminates in a trident of black spines; median area of ninth tergite somewhat similarly produced into a long lobe bearing coarse setae; outer dististyle with the outer lobe narrow.

Male.—Length about 10 mm.; wing 9.5 mm.; antennae about 4 mm.

Frontal prolongation of head short, black; palpi black. Antennae black, the pedicel obscure yellow; flagellum relatively short, less than one-half the length of body; segments cylindrical, with verticils that are shorter than the segments; pubescence of segments short and inconspicuous. Head brownish black, the anterior vertex paler, relatively narrow, less than two times the diameter of scape.

Mesonotal praescutum almost uniformly dark reddish brown, with indications of a median and shorter lateral brown stripes; humeral and lateral portions of praescutum more blackened; posterior sclerites of notum dark brown, the median region of scutum and scutellum a little paler; mediotergite and pleurotergite more reddish brown. Pleura brownish black. Halteres with stem and apex of knob obscure yellow, base of knob weakly darkened. Legs with coxae dark brown; trochanters yellow; remainder of legs black, the femoral bases very narrowly yellow. Wings strongly darkened, especially the costal border and outer radial field; stigma darker brown; veins and trichia brownish black. Macrotrichia of cells abundant, including all but the basal fourth of wing and involving the distal half of cell *2nd A*. Venation: R_{1+2} preserved as a weak spur; petiole of cell M_1 a little shorter than *m;* cell *1st* M_2 long and narrow, a trifle widened outwardly but still approximately parallel-sided.

Abdominal segments weakly bicolored, yellowish brown, the incisures narrowly blackened, involving both the apices and bases of the individual segments; hypopygium darkened. Male hypopygium (Fig. 11) with the eighth sternite, *8s,* produced into an elongate median lobe that is tipped with three conspicuous black spinous setae. Ninth tergite, *9t,* somewhat similarly produced into a long median lobe that is a little expanded at distal end and provided with

long coarse setae; lateral tergal lobes low, with a close group of about a dozen setae. Basistyle, *b*, produced into a conspicuous lobe that bears numerous short black spines at apex, with a few longer spines along mesal face. Outer dististyle, *od* more elongate than in *devexa*, especially the narrow outer lobe, the inner mesal lobe slender, provided with blackened setae. Beak of inner dististyle, *id*, small.

Habitat.—Cuba (Oriente).

Holotype, ♂, Pico Turquino, Sierra Maestra, north side, altitude 4,500–6,000 feet, June 18–20, 1936 (Darlington).

Named in honor of the collector, Dr. P. J. Darlington, Jr. The nearest ally is *Dolichopeza (Megistomastix) devexa* Alexander, which is well-distinguished by the elongate antennae that are more than twice as long as in the present fly. The structure of the male hypopygium differs in all details. The somewhat remarkable lobe of the eighth sternite of the present fly is represented in *devexa* by a smaller pale unarmed lobe.

Dolichopeza *(Megistomastix)* **domingensis** sp. n.

General coloration dark gray; antennae relatively short, black, with inconspicuous verticils and pubescence; pleura variegated yellow and brownish black; halteres black; legs black, the femoral bases restrictedly obscure yellow; wings strongly infuscated, the stigma darkened; certain of the veins seamed with brown; obliterative areas at cord conspicuous; macrotrichia of cells abundant, present on distal three-fourths of wing; R_{1+2} entire; cell M_1 sessile; abdominal tergites black, the lateral margins obscure yellow; male hypopygium with the inner dististyle unusually broad, its apex obtuse; eighth sternite with the median lobe low and obtuse, without modified spines or setae.

Male.—Length about 9 mm.; wing 10.8 mm.; antennae about 3.6 mm.

Rostrum obscure brownish yellow; palpi black. Antennae relatively short, black, the pedicel a little brightened; flagellar segments subcylindrical, the verticils much shorter than the segments, pubescence short. Head dark brown.

Pronotum dark brown. Pretergites and humeral region of praescutum restrictedly pale. Disk of praescutum covered by confluent dark gray stripes, obliterating the interspaces and restricting the brownish black ground to the lateral borders; scutal lobes dark gray, slightly variegated by blackish, the median area narrowly pale; scutellum polished black, the parascutella pale, slightly marked with

darker; mediotergite brown, more blackened laterally. Pleura yellow, variegated with brownish black areas, especially on the propleura and anepisternum and again on the ventral sternopleurite and meron; a dark spot on ventral pleurotergite. Halteres black, the base of stem restrictedly yellow. Legs with coxae and trochanters yellowish testaceous; remainder of legs black, the femoral bases restrictedly obscure yellow. Wings (Fig. 2) strongly infuscated, the stigma darker; cells *C* and *Sc*, together with a seam on *m-cu*, a little darker than the ground; conspicuous whitish obliterative areas before stigma and especially across bases of cells *1st* M_2 and M_3; veins beyond cord and tip of *2nd A* rather insensibly seamed with darker; veins and trichia dark brown. Macrotrichia of cells abundant, including virtually the whole wing with the exception of the proximal fourth (represented in figure by stippling); in the outer cells where the veins are seamed with darker, the trichia are more restricted to the centers of the cells. Venation: R_{1+2} entire; *Rs* short, oblique, subequal to basal section of R_{4+5}; cell M_1 broadly sessile.

Abdomen with tergites black, paling to obscure yellow on sides; sternites chiefly yellow, the incisures darkened, more especially involving the bases of the segments. Male hypopygium (Fig. 12) with lobe of eighth sternite, *8s*, very low and broad, provided only with normal setae. Caudal margin of ninth tergite, *9t*, generally transverse to very feebly emarginate, with abundant coarse black setae. Region of basistyle, *b*, with coarse black spines that are continued based on the face of style. Outer dististyle, *od*, scarcely modified. Inner dististyle, id, with the blade very broad, the apex obtuse.

Habitat.—Dominican Republic.

Holotype, ♂, Loma Rucilla, altitude 5,000–10,000 feet, June 1938 (Darlington).

Dolichopeza (Megistomastix) domingensis is so distinct from the other described species of the subgenus that it requires little comparison. It is the only species having vein R_{1+2} entire and cell M_1 sessile. The structure of the male hypopygium is somewhat unusually generalized. The subgenus *Megistomastix* had not hitherto been recorded from Hispaniola though represented by somewhat numerous species in Puerto Rico and Cuba.

Limonia (Discobola) gowdeyi (Alexander).

Cuba: San Blas, Santa Clara, Trinidad Mountains, altitude 700 feet, July 1926, December 4, 1931 (Rowe). Pico Turquino, Sierra Maestra, Oriente, south side, altitude 3,000–5,000 feet, June 1936 (Darlington).

Limonia (Limonia) hoffmani Alexander.

Puerto Rico: El Semille, Villalba, altitude 1,600 feet, at light, January 26, 1935 (W. A. Hoffman).

Limonia (Limonia) umbrata (de Meijere).

Dicranomyia umbrata de Meijere, Tijd. voor Ent., 54; 25–26; 1911.

Limonia fissilis Alexander, Ann. Ent. Soc. America, 19:159; 1926.

Widely distributed in eastern Asia. Apparently introduced by commerce into the Neotropical Region. The type-locality of *fissilis* is Vera Cruz, Mexico.

Cuba: Sierra Rangel, Pinar del Río, altitude 1,500 feet, 1936 (Brother Chrysogone, Colegio de la Salle, Havana).

Limonia *(Limonia)* **domballah** sp. n.

General coloration of mesonotum black, the praescutum more obscure yellow and castaneous; pleura black; knobs of halteres yellow; femora yellow, narrowly ringed with black before tips; wings yellow, patterned with brown; *Rs* angulated and spurred at origin; abdominal segments black, the caudal borders narrowly yellow.

Female.—Length about 10 mm.; wing 10 mm.

Rostrum and palpi black. Antennae black throughout; flagellar segments oval, with very short apical necks; longest verticils a little exceeding the segments. Head with the front and narrow anterior vertex gray; remainder of vertex and the occiput black. the orbits weakly dusted with gray.

Pronotum black medially above, obscure yellow on sides. Mesonotal praescutum polished obscure yellow, more castaneous behind, with three black stripes, the median one intense only on cephalic portion, becoming obsolete at or before midlength of sclerite; lateral stripes appearing as major areas on sides of praescutum, crossing the dorsopleural region and becoming confluent with the blackened pleura; scutal lobes black, the median area brownish yellow; scutellum and postnotum shiny black. Pleura and pleurotergite uniformly black. Halteres with base of stem and the knob obscure yellow, the distal portion of stem infuscated. Legs with the coxae yellow, the fore coxae a trifle darkened on anterior face; trochanters yellow; femora yellow, with a narrow black subterminal ring that is a little wider than the yellow apex; tibiae yellowish brown, the tips narrowly

darkened; remainder of legs black. Wings (Fig. 3) yellow, with a conspicuous brown pattern, as follows: Extensive washes in basal cells from *Sc* to margin in cell *2nd A*, at origin of *Rs*, cord and outer end of cell *1st* M_2; stigma oval, darker brown; wing-tip weakly infumed; veins brown. Venation: Sc_1 ending about opposite four-fifths the length of *Rs*, Sc_2 at its tip; a short spur of R_{1+2}; *Rs* angulated and spurred at origin; free tip of Sc_2 and R_2 in transverse alignment; inner end of cell R_3 lying far proximad of either cell R_5 or *1st* M_2; cell *1st* M_2 subequal in length to vein M_3 beyond it; *m-cu* a short distance before fork of *M;* cell *2nd A* wide.

Abdominal tergites black, the caudal borders of the segments narrowly ringed with yellow, on the subterminal segments uniformly blackened; basal sternites obscure yellow, the remaining segments patterned as on the tergites. Ovipositor with the cerci relatively small and slender, gently upcurved to the acute tips.

Habitat.—Dominican Republic.

Holotype, ♂, Loma Rucilla and mountains to north, altitude 5,000–8,000 feet, June 1938 (Darlington).

The name, *Domballah,* is that of the Father of the Gods of the Voodoos in Hispaniola. The species is very distinct from all described regional species, especially in the uniformly blackened pleura and in the pattern of the wings.

Limonia *(Dicranomyia)* **calliergon** sp. n.

General coloration gray, variegated with black; cephalic half of mesonotal praescutum uniformly brownish gray, the posterior half clearer gray, with four distinct black stripes; knobs of halteres black; legs black, the femoral bases yellow, broadest on fore legs; tips of all femora narrowly whitish yellow; wings whitish subhyaline, reticulately patterned with dark brown; a complete white crossband before cord; *m-cu* oblique, before the fork of *M,* longer than the distal section of Cu_1; abdomen yellow; male hypopygium with two rostral spines from a single common tubercle.

Male.—Length about 6–6.5 mm.; wing 6.4–7 mm.

Female.—Length about 7–7.5 mm.; wing 7.5–8 mm.

Rostrum and palpi black, the former a little pruinose. Antennae with scape black, pruinose; pedicel obscure yellow; basal flagellar segments brownish yellow, the outer segments passing into black; flagellar segments oval. Head black, variegated with silvery, on the anterior vertex a little more golden pollinose.

Mesonotal praescutum gray, the cephalic half more uniformly brownish gray, unstriped; on posterior half with four clearly defined black stripes, the intermediate pair not reaching the suture, the laterals fused with the dark lateral margin, crossing the suture and suffusing most of the scutal lobes; median area of scutum and the scutellum broadly light gray, parascutella dark; mediotergite chiefly blackened, variegated with gray on sides; lateral borders of pronotum and praescutum blackened. Pleura gray, variegated with velvety black, especially on anepisternum, dorsal pteropleurite and pleurotergite. Halteres with stem pale yellow, knob black. Legs with fore coxae blackened, remaining coxae more pruinose; trochanters brown; femora black, the bases light yellow, more extensively so on fore legs where about the basal third is included, less so on the middle and posterior legs where only about the proximal eighth is involved; tips of all femora narrowly but very conspicuously whitish yellow, the amount subequal on all legs; remainder of legs black. Wings with the ground color whitish subhyaline, handsomely patterned with dark brown on cephalic portion and more grayish brown behind; pattern more or less reticulate, with a complete white crossband before cord; before the cord with from nine to twelve costal dark rays, cell *Sc* uniformly darkened; in cell *R* at base, before mid-distance to origin of *Rs* and at the origin of the latter with dark lines that reach vein *M* behind or virtually so; beyond the cord and stigma a similar muscoid pattern that sends about four or five rays to costal border at stigma and about three or four others to above the termination of vein R_3, these latter areas extensively darkened and fused behind in the proximal portion of the outer radial field; posterior cells of wing more sparsely reticulate with grayish brown, chiefly evident as marginal rays in all the cells; cells adjoining vein *Cu* slightly suffused with brown; prearcular field slightly more yellow; veins pale, darker in the patterned areas. Venation: *Rs* angulated and more or less spurred at origin; Sc_1 extending a short distance beyond origin of *Rs* to near one-fourth the length, Sc_2 close to tip; cell *1st* M_2 relatively large, longer than any of the veins beyond it; *m-cu* oblique, before the fork of *M*, longer than the distal section of Cu_1; cell *2nd A* wide.

Abdomen conspicuously pale yellow; in cases, the subterminal segments more weakly infuscated; hypopygium yellow. Male hypopygium with the tergite transverse, the caudal margin gently emarginate. Dorsal dististyle a gently curved sickle, the long drawn tip acute. Ventral dististyle fleshy, a little larger than the basistyle;

rostral prolongation stout, on outer margin beyond midlength with a single tubercle that bears two subequal spines, these latter about twice as long as the tubercle. Gonapophyses with mesal-apical lobe stout, with a coarsely and irregularly serrated lateral flange.

Habitat.—Haiti.

Holotype, ♂, La Visite and vicinity, La Selle Range, altitude 5,000–7,000 feet, September 16–23, 1934 (Bates). Allotopotype, ♀. Paratopotypes, 10 ♂ ♀.

A very distinct species, superficially resembling species like *Limonia (Dicranomyia)* reticulata (Alexander) or *L.* (*D.*) *pampoecila* (Alexander), yet entirely distinct. I am placing it in the subgenus *Dicranomyia* despite the fact that Sc_1 ends a short distance beyond the origin of *Rs*, as in *Limonia*, s.s.

Limonia *(Dicranomyia)* **calliergon polygrapha** subsp. n.

Male.—Length about 6 mm.; wing 7 mm.

Close to typical *calliergon*, differing as follows:

Scutellum with darkened extensions from the scutal lobes, on either side of median line. Femora more extensively yellow, with moderately broad, black, nearly terminal rings; tibiae yellow, the bases narrowly black, the tips and all tarsi broken. All legs of the unique type are detached and thus cannot be safely associated with any given trochanter. Wings with the dark reticulate pattern much more extensive, the costal rays narrow and entire; cells *R* and *M* with darkened areas, as in the other cells; white crossband before cord narrower and less evident; veins dark, including those in the ground areas, and therefore much more distinct. Male hypopygium with the ventral dististyle smaller than in the typical form, the rostral spines arising from a similar conspicuous basal tubercle but unequal in length, the outer about three-fourths the length of the inner and closely applied to it.

Habitat.—Dominican Republic.

Holotype, ♂, Valle Nuevo, southeast of Constanza, altitude about 7,000 feet, August 1938 (Darlington).

Although the coloration of the thorax and general pattern of the wings is very similar in the two forms, the differences in the color of the legs and wings, and the nature of the rostral spines of the male hypopygium, in the present fly, incline me to believe that it may be found to represent a valid species rather than a subspecies.

Limonia (Dicranomyia) reticulata (Alexander).

Cuba: San Blas, Santa Clara, Trinidad Mountains, August 12, 1932 (Bates & Fairchild). Sierra Rangel, Pinar del Río, January 27–30, 1931 (Acuña & Otero).

Limonia *(Dicranomyia)* **indefensa** sp. n.

General coloration medium brown, the praescutum unpatterned; antennae black throughout; halteres black, the base of stem yellow; legs dark brown, the femoral tips not brightened; wings with a brown tinge, the oval stigma darker brown; vague brown seams along cord and outer end of cell *1st* M_2; abdominal tergites dark brown, the sternites weakly bicolored, reddish brown, the outer half of the segments darker.

Female.—Length about 9 mm.; wing 9.3 mm.

Rostrum and palpi black throughout; flagellar segments long-oval. Head black; anterior vertex about equal in width to the diameter of the scape.

Pronotum brown. Mesothorax almost uniformly medium brown, without markings, the pleura scarcely paler. Halteres black, base of stem pale. Legs with the coxae pale brown; trochanters greenish testaceous; remainder of legs dark brown, the femoral tips not brightened. Wings with a brown tinge, the oval stigma darker brown; paler brown, poorly defined seams on cord and outer end of cell *1st* M_2; veins pale brown. Venation: Sc_1 ending just beyond origin of *Rs*, Sc_2 shortly before this point; free tip of Sc_2 and R_2 in transverse alignment; cell *1st* M_2 subequal in length to the longest veins beyond it; *m-cu* close to fork of *M*.

Abdominal tergites dark brown; sternites weakly bicolored, reddish brown basally, the outer half of each segment somewhat darker. Ovipositor with cerci slender, very gently upcurved.

Habitat.—Haiti.

Holotype, ♀, La Visite, La Selle Range, altitude 5,000–7,000 feet, September 16–23, 1934 (Bates).

Limonia (Dicranomyia) indefensa is quite distinct from the other regional species of the subgenus. It is apparently closest to *L. (D.) humidicola* (Osten Sacken) and allies, differing in the coloration of the body and wings, and in the uniformly darkened femora.

Limonia (Dicranomyia) divisa Alexander.

Haiti: La Visite and vicinity, La Selle Range, altitude 5,000–7,000 feet, September 16–23, 1934 (Bates).

Puerto Rico: El Semille, Villalba, altitude 1,600 feet, at light January 26, 1935 (W. A. Hoffman).

Limonia (Neolimnobia) diva (Schiner), var.

Cuba: Sierra Rangel, Pinar del Río, January 27–30, 1931 (Acuña & Otero).

Limonia (Rhipidia) schwarzi (Alexander).

Cuba: Sierra Rangel, Pinar del Río, January 27–30, 1931 (Acuña & Otero).

Jamaica: Balaclava (A. E. Wight).

Limonia (Rhipidia) domestica (Osten Sacken).

Cuba: San José, July 7 (at light). Santiago de las Vegas, April 7, 1930 (Otero). San Blas, Santa Clara, Trinidad Mts., altitude 700 feet, January 1, 1932 (Rowe). Sierra Rangel, Pinar del Río, January 27–30, 1931 (Acuña & Otero).

Puerto Rico: El Semille, Villalba, altitude 1,600 feet, at light, January 26, 1935 (Hoffman).

Jamaica: Balaclava; Moneague, February 2–3 (W. S. Brooks). Port Antonio, (A. E. Wight).

Limonia (Geranomyia) antillarum Alexander.

Cuba: Buenos Aires, Santa Clara, Trinidad Mountains, May 14, 1932 (Acuña).

Puerto Rico: El Semille, Villalba, altitude 1,600 feet, at light, January 26, 1935 (Hoffman).

Limonia (Geranomyia) myersiana Alexander.

Cuba: San Blas, Santa Clara, Trinidad Mountains, altitude 700 feet, December 4, 1931 (Rowe). Sierra Rangel, Pinar del Río, January 27–30, 1931 (Acuña & Otero).

Puerto Rico. El Semille, Villalba, altitude 1,600 feet, at light, January 26, 1935 (Hoffman).

Limonia (Geranomyia) tibialis (Loew).

Cuba: San Blas, Santa Clara, July 20, 1932 (Bates & Fairchild). Sierra Rangel, Pinar del Río, January 27–30, 1931 (Acuña & Otero).

Puerto Rico: El Semille, Villalba, altitude 1,600 feet, at light, January 26, 1935 (Hoffman).

Jamaica: Balaclava (A. E. Wight). Port Antonio (A. E. Wight).

In the Port Antonio specimen the praescutal stripes are obsolete or nearly so, but the identity seems certain. Whether the species is the same as the earlier *L. (G.) intermedia* (Walker) remains in question yet is entirely possible.

Limonia *(Geranomyia)* **banksiana** sp. n.

Allied to *canadensis;* general coloration of praescutum medium brown, without stripes; scutellum brown, with a vague central paler area; mediotergite dark brown, the apical portion yellow; legs brown; wings subhyaline, unmarked except for the oval, pale brown stigma; Sc_1 ending about opposite midlength of *Rs; r-m* greatly reduced by the approximation of veins R_{4+5} and M_{1+2}; male hypopygium with the lobes of ninth tergite rounded, provided with conspicuous setae, the extensive median area glabrous; ventral dististyle large and fleshy; rostral prolongation short, with two subequal spines arising from very unequal tubercles, the shortest one close to apex of prolongation; mesal-apical lobe of gonapohysis entirely pale, simple, nearly straight.

Male.—Length, excluding rostrum, about 6 mm.; wing 6.4 mm.; rostrum approximately 2.6 mm.

Rostrum relatively long, brown, the tips of paraglossae darker brown. Antennae dark brown, the scape a little paler brown. Head grayish brown; anterior vertex narrow, subequal to diameter of scape.

Mesonotal praescutum medium brown, without stripes; humeral region a little more yellowish; scutal lobes pale brown, the median area pale yellow; scutellum brown, with a vague central paler area; mediotergite dark brown, with less than the apical half yellow. Pleura brownish yellow, unmarked. Halteres pale. Legs with the coxae and trochanters obscure yellow, the fore coxae a trifle darker; remainder of legs pale brown, the terminal tarsal segments dark brown. Wings, subhyaline, the oval stigma pale brown; veins brown. Numerous macrotrichia on veins beyond cord, as well as a complete series on *Rs*. Venation: *Sc* relatively long, Sc_1 ending about opposite midlength of *Rs*, Sc_2 a short distance from its tip; *r-m* greatly reduced by the approximation of veins R_{4+5} and M_{1+2}; *m-cu* close to fork of *M*; cell *2nd A* relatively narrow.

Basal abdominal segments brown, the outer segments somewhat more bicolored, darker brown at apex than at base; hypopygium dark. Male hypopygium (Fig. 14) with the outer angles of ninth

tergite, *9t*, produced into rounded lobes that are provided with conspicuous setae, the extensive intermediate area glabrous. Ventromesal lobe of basistyle large. Ventral dististyle, *vd*, large and fleshy, much more extensive than the basistyle; rostral prolongation short, with two spines arising from unequal tubercles; outer spine placed very close to apex of prolongation on a low tubercle; second spine subequal in length, arising a little farther basad and from a much longer tubercle that exceeds one-third the length of spine. Mesal-apical lobe of gonapophysis, *g*, entirely pale, simple, nearly straight.

Habitat.—Cuba.

Holotype, ♂, Soledad, near Cienfuegos, August 6, 1920 (Banks).

I take very great pleasure in naming this fly in honor of the collector, Dr. Nathan Banks, to whom I am greatly indebted for many appreciated favors. Although generally similar in its general appearance to *Limonia (Geranomyia) canadensis* (Westwood), the present fly is very distinct in the structure of the male hypopygium.

Limonia (Geranomyia) subvirescens Alexander.

Cuba: Loma de la Sierra, Santiago de las Vegas, March 5, 1931 (Acuña & Otero).

Limonia *(Geranomyia)* **subvirescens jamaicae** subsp. n.

Male.—Length, excluding rostrum, about 5 mm.; wing 5 mm.; rostrum about 3 mm.

Female.—Length, excluding rostrum, about 6 mm.; wing 5.8 mm.; rostrum about 3 mm.

Rostrum pale yellowish brown, the tips of the paraglossae strongly recurved. Antennae dark brown throughout; flagellar segments oval. Head dark brown.

Thorax uniform orange yellow, unmarked. Halteres pale. Legs yellow throughout. Wings pale yellow, the subcircular stigma pale brown; veins brownish yellow. Venation: *Sc* moderately long, Sc_1 ending about opposite two-thirds the length of *Rs*, Sc_2 at its tip; *Rs* about twice the basal section of R_{4+5}; *m-cu* at fork of *M*; cell *2nd A* relatively narrow.

Abdomen yellow. Male hypopygium much as in typical *subvirescens* Alexander (Cuba) but apex of rostral prolongation of ventral dististyle much more slender, the diameter at this point only about one-third the length of the rostral spines. In *subvirescens*, the transverse diameter beyond the rostral spines is more than one-half the length of the spines.

Habitat.—Jamaica.

Holotype, ♀, Port Antonio (A. E. Wight). Allotopotype, ♂, in poor condition.

In typical *subvirescens*, the wings are subhyaline, with the brown veins much more distinct.

Limonia (Geranomyia) virescens (Loew).

Puerto Rico: El Semille, Villalba, altitude 1,600 feet, at light, January 26, 1935 (Hoffman).

Orimarga (Diotrepha) mirabilis (Osten Sacken).

Cuba: Santo Tomás, Province of Zapata, May 5–9, 1927 (Acuña & Bruner).

Helius (Helius) albitarsis (Osten Sacken).

Cuba: Sierra Rangel, Pinar del Río, altitude 1,500 feet, April 26, 1933 (Bruner & Otero); January 27–30, 1931 (Acuña & Otero).

Ephiphragma (Epiphragma) cubcnsis Alexander

Cuba: Sierra Rangel, Pinar del Río, January 27–30, 1931 (Acuña & Otero).

Epiphragma *(Epiphragma)* **auricosta** sp. n.

General coloration brown and yellow; antennae (male) short, black; first flagellar segment yellow; femora yellow, with three black rings; tibiae chiefly dark brown to black, the tarsi paling to obscure yelow; wings yellow, the cephalic third more saturated, butter-yellow, with an ocelliform pattern.

Male.—Length about 9–10 mm.; wing 11–12 mm.; antennae about 2.3–2.4 mm.

Female.—Length about 12–13 mm.; wing 11.5–12 mm.

Rostrum dark brown; palpi black. Antennae short, black, the basal segment of flagellum yellow; flagellar verticils exceeding the segments in length. Head chestnut brown, with a dark brown transverse band across anterior vertex and a less distinct median darkening on posterior vertex; posterior portions of vertex more or less white pruinose.

Pronotum dark brown, more yellowish on sides. Mesonotal praescutum with the ground color reddish brown, with three conspicuous, dark brown stripes on cephalic half, on posterior half becoming obscured and confluent, more uniformly dark brown; humeral regions

of praescutum restrictedly pale, more extensively bordered internally by dark brown, the lateral margins behind the pseudosutural foveae broadly dark brown; in still other specimens, the color of the praescutum varies from uniform dark brown to striped with dark throughout the length; scutum chiefly brownish yellow, contrasting abruptly with the praescutum; scutellum and postnotum dark colored, light gray pruinose, the mediotergite and pleurotergite with their posterior borders broadly dark brown. Pleura with the propleura and pleurotergite chiefly dark brown, the mesopleura almost uniformly pale. Halteres elongate, stem obscure yellow, knob brown. Legs with the coxae obscure brownish yellow; trochanters yellow; femora yellow, with three black rings, the last terminal, the median one about twice as wide as the yellow ring on either side; basal dark ring narrow and somewhat paler; tibiae dark brown to black, in cases the extreme tips reddish; basitarsi dark brown, remainder of tarsi paling to obscure brownish yellow. Wings with the ground color yellow, the cephalic third more saturated butter-yellow; a conspicuous, chiefly ocelliform, dark pattern, including ocelli beyond arculus, origin of *Rs*, cord, outer end of cell *1st* M_2 and fork of *M*; in region of stigma, several small, more blackish areas; a solidly darkened mark in cells *Cu*, *1st A* and *2nd A*, in alignment with the ocellate area at origin of *Rs*; areas in cell *2nd A* about three in number, the intermediate ones in cases interconnected; veins brown, more yellowish in the costal interspaces. Venation: *m-cu* not more than its own length beyond the fork of *M*.

Abdominal tergites dark brown, the caudal margins broadly more grayish; sternites and hypopygium more yellow to brownish yellow. Male hypopygium with the lobes of the tergite obtusely rounded, separated by a deep linear notch. Interbases with short triangular apical points.

Habitat.—Dominican Republic.

Holotype, ♂, Valle Nuevo, southeast of Constanza, altitude about 7,000 feet, August 1938 (Darlington). Allotopotype, ♀. Paratopotype, 1 ♀; paratypes, 1 sex?, Foothills of the Cordillera Central, south of Santiago, June 1938; 1 ♂, Loma Rucilla, altitude 8,000-10,000 feet, June 1938 (Darlington).

Epiphragma (Epiphragma) auricosta is very different from the three other species known from the Greater Antilles, especially in the strongly yellow wings and the pattern of the legs, as the three-banded femora and darkened tibiae.

Epiphragma (Epiphragma) buscki Alexander.

Haiti: Desbarriere, Mt. La Hotte, altitude about 4,000 feet, October 12–14, 1934 (Darlington).

Epiphragma *(Epiphragma)* **inornatipes** sp. n.

General coloration of praescutum brownish yellow, the cephalic fourth darkened, the remainder with narrow brown stripes; pleura gray pruinose, the dorsopleural region and membrane dark brown; femora almost uniformly brown, the tips narrowly pale, tibiae and tarsi yellow; wings whitish subhyaline, patterned with brown, much as in *solatrix*; dark areas in outer radial field large and full, dark areas in cell *2nd A* very extensive, involving the central portion of cell; male hypopygium with the inner dististyle relatively narrow, with conspicuous setae.

Male.—Length about 11.5 mm.; wing 12.3 mm.

Rostrum brown; palpi black. Antennae with scape and pedicel black, flagellum broken. Head chiefly brown, the posterior orbits more grayish; anterior vertex behind antennae more blackened.

Pronotum light brown, narrowly blackened medially, more broadly so on sides. Mesonotal praescutum with cephalic fourth almost uniformly darkened, the remainder more brownish yellow with four narrow brown stripes that do not reach the suture behind, the lateral pair much reduced; lateral borders of praescutum behind pseudosutural fovea more uniformly darkened, the suture bordered by brown; scutum with cephalic half buff, the posterior half almost covered by a transverse brown band; scutellum buffy; mediotergite pale, the posterior third and a narrow transverse line at near midlength darker brown. Pleura chiefly gray pruinose, variegated with brownish black, especially on dorsal pleurites and the dorsopleural region. Halteres with stem yellow, knob more or less darkened, the apex narrowly pale. Legs with the coxae gray, the extreme base of fore pair darkened; trochanters yellow; femora almost uniform brown, paler basally, the apex narrowly pale; tibiae and tarsi yellow. Wings whitish subhyaline, heavily patterned with brown, the areas of cephalic and apical portions paler brown with narrow dark borders; in Anal field, the areas uniformly dark brown; stigma narrow, almost uniformly dark brown; wing pattern somewhat as in *solatrix* yet differing in certain important points; dark areas in cell *C* more extensive than the interspaces; marginal areas in outer radial field large and full; dark areas in cell *2nd A* very extensive, involving the central portion of cell.

Abdominal segments variegated dark and paler brown, the lateral borders buffy. Male hypopygium with the outer dististyle relatively narrow, the tip decurved; inner dististyle narrower than in *solatrix,* provided with conspicuous setae. Interbases with apical spines recurved.

Habitat.—Cuba.

Holotype, ♂, Pico Turquino, Sierra Maestra, Oriente, north side, altitude 4,500–6,000 feet, June 18–20, 1936 (Darlington).

Epiphragma (Epiphragma) inornatipes is apparently closest to the smaller *E. (E.) solatrix* (Osten Sacken), having the pattern of the femora virtually the same. It differs in the coloration of the body and wings, and in the details of structure of the male hypopygium.

Shannonomyia batesi sp. n.

Belongs to the *mesophragma* group; mesonotum gray; halteres pale yellow; femora yellow with a brownish black subterminal ring, on fore and middle femora with the basal third or more similarly blackened; wings yellow, spotted and dotted with brown; cell *1st* M_2 closed, elongate, with *m-cu* at near one-third the length.

Male.—Length about 5.5–6 mm.; wing 6–6.5 mm.

Female.—Length about 7.5–8 mm.; wing 6.5–7 mm.

Rostrum and palpi black. Antennae yellow, the outer flagellar segments infuscated; in darker individuals the antennae are more uniformly brown throughout; flagellar segments oval. Head gray.

Mesonotum gray, the praescutum with a slightly darker gray median stripe, the scutal lobes similarly darkened. Pleura black, gray pruinose. Halteres pale yellow throughout. Legs with the coxae black, pruinose; trochanters yellow; femora yellow, with a conspicuous, dark brown to brownish black ring before the subequal or narrower yellow apex; fore and middle femora with the basal third or more similarly blackened, leaving only a relatively narrow, obscure yellow ring between the two dark bands; posterior femora less distinctly or not at all darkened at base; tibiae and tarsi yellow, the tips of the latter darkened. The females seem to have darker legs than the males and at least one specimen has the fore and middle femora uniformly blackened with the exception of the narrow yellow bases; hind femora less evidently blackened except at tips; in all cases the fore and middle femora are more extensively blackened than are the posterior femora. Wings (Fig. 4) with the ground color yellow, the prearcular and costal fields a little deeper yellow to brownish yellow; a heavy spotted and dotted brown pattern, the

largest areas at stigma, more or less confluent with a seam along cord; smaller brown spots at origin of *Rs*, supernumerary crossvein in cell *R*, *m-cu* and outer ends of veins R_3 and R_4; small brown marginal spots at ends of longitudinal veins, usually more extensive at *2nd A;* numerous to somewhat sparse brown dots in most cells of wing; veins yellow, darker in the clouded areas. Venation: Sc_1 ending at near two-thirds the length of *Rs*, Sc_2 near its tip; a supernumerary crossvein in *cell R* connecting with *Rs* about its own length beyond origin; *r-m* strongly bowed; cell *1st* M_2 closed, elongate, longer than any of the veins beyond it; *m-cu* at near one-third the length; basal section of M_3 variable in length, from short and nearly straight to arcuated or even feebly angulated.

Abdomen black, sparsely pruinose; hypopygium reddish brown.

Habitat.—Haiti.

Holotype, ♂, La Visite and vicinity, La Selle Range, altitude 5,000–7,000 feet, September 16–23, 1934 (Bates). Allotopotype, ♀. Paratopotypes, 9 ♂ ♀.

I take great pleasure in naming this very distinct fly in honor of the collector, Mr. Marston Bates. The species and the two next described are the first species of the genus to be discovered in Hispaniola. By my key to the Cuban members of the genus (Journ. Agr. Univ. Puerto Rico, 21: 526–527; 1937), the present fly runs to *Shannonomyia phragmophora* Alexander. It differs from all three Cuban members of the group in the numerous dots in the cells of the wings and in the heavy dark pattern of the femora.

Shannonomyia haitensis sp. n.

General coloration gray, the praescutum with vaguely darker stripes; basal three antennal segments yellow, the remainder black; head and pronotum clear light gray; legs yellow; wings whitish subhyaline, conspicuously patterned with brown, the areas confined to the vicinity of the veins; *Rs* relatively short, angulated at origin; R_2 some distance before fork of cell R_3; vein R_4 strongly upcurved at tip; *r-m* strongly bowed; cell *1st* M_2 elongate.

Male.—Length about 5–5.5 mm.; wing 5–6 mm.

Female.—Length about 6.5–7 mm.; wing 5.5–6.5 mm.

Rostrum gray; palpi black. Antennae short; basal three segments yellow, the remainder of flagellum black; flageller segments oval, much longer than the segments. Head light gray; anterior vertex relatively wide, exceeding two times the diameter of scape.

Pronotum clear light gray; lateral pretergites similarly clear gray. Mesonotal praescutum light gray to brownish gray, with three darker gray stripes; scutal lobes similarly darkened; scutellum gray, with a capillary brown median vitta; mediotergite gray pruinose. Pleura gray, somewhat variegated with darker gray, especially dorsally and on ventral sternopleurite. Halteres pale yellow. Legs with the coxae yellow, fore coxae a trifle darker; trochanters yellow; remainder of legs yellow, the outer tarsal segments a trifle darker. Wings (Fig. 5) whitish subhyaline, with a conspicuous pattern that is confined to the vicinity of the veins, arranged as follows: Arculus; origin of *Rs;* fork of *Sc;* stigma; cord and outer end of cell *1st* M_2; marginal spots at ends of all longitudinal veins, smallest on R_5, largest on *2nd A;* in cases, dark clouds at fork of R_{2+3+4} and at intervals along distal section of M_{1+2}; veins yellow, darker in the clouded areas. Venation: *Rs* relatively short, angulated and, in cases, short-spurred at origin; Sc_1 ending at or beyond three-fourths the length of *Rs;* R_2 some distance before fork of cell R_3; vein R_4, and usually R_3 also, strongly upcurved at tip; *r-m* very strongly bowed; cell *1st* M_2 elongate, subequal to or longer than vein M_{1+2} beyond it; *m-cu* at from one-third to near one-half the length of the cell.

Abdomen dark brown, including the hypopygium.

Habitat.—Haiti.

Holotype, ♂, La Visite and vicinity, La Selle Range, altitude 5,000–7,000 feet, September 16–23, 1934 (Bates). Allotopotype, ♀. Paratopotypes, 6 ♂ ♀.

Shannonomyia haïtensis is very different from the described Cuban and Puerto Rican species of the genus. It is perhaps closest to *S. brevicula* Alexander, of Cuba, differing notably in the pattern and venation of the wings.

Shannonomyia septem-punctata sp. n.

General coloration pale yellow, including the antennal flagellum, halteres and legs; wings yellow, with seven conspicuous brown spots; *Rs* unusually long, exceeding vein R_4, angulated and short-spurred at origin; R_2 shortly before fork of cell R_3; *m-cu* shortly before midlength of the long cell *1st* M_2.

Female.—Length about 6.5 mm.; wing 6.2 mm.

Rostrum and palpi brown. Antennae short; scape brown; succeeding segments pale, the outer ones a little darker; flagellar segments oval. Head brownish yellow to pale brown, darker anteriorly.

Thorax uniformly pale yellow, virtually unmarked; central portion of scutum and adjoining median portion of praescutum somewhat clearer yellow; scutellum and mediotergite with a vague darker median vitta. Halteres pale yellow. Legs yellow, the terminal tarsal segments darkened. Wings (Fig. 6) yellow, the prearcular and costal portions a trifle more saturated yellow; seven conspicuous brown spots, as follows: At arculus; origin of *Rs;* stigma; basal section of R_5; remainder of anterior cord at end of vein *M;* outer end of cell *1st* M_2; *m-cu;* veins yellow, darker in the clouded areas. Venation: *Rs* unusually long, exceeding vein R_4, angulated and short-spurred at origin; R_2 subequal to R_{1+2}, placed just before fork of cell R_3; *r-m* arcuated, lying proximad of vein R_5; cell *1st* M_2 elongate, subequal to the veins beyond it, with *m-cu* shortly before midlength.

Abdomen obscure yellow, the incisures of the more basal tergites a little darker. Ovipositor with unusually long and slender valves, especially the cerci.

Habitat.—Dominican Republic.

Holotype, ♂, Valle Nuevo, southeast of Constanza, altitude about 7,000 feet, August 1938 (Darlington).

Shannonomyia septem-punctata is quite distinct from all other species known from the Neotropics. The almost uniformly yellow color, conspicuously patterned wings and unusually long *Rs* will suffice for the recognition of the fly.

Hexatoma (Eriocera) bruneri (Alexander).

Cuba: Coast below Pico Turquino, Oriente, June 26–30, 1936 (Darlington). Near Santiago, September 4, 1928 (Bruner).

The first specimen listed, as well as the holotype specimen, shows a crossvein in cell *Sc* beyond the origin of *Rs,* this being lacking in the second specimen above listed and evidently not entirely constant.

Hexatoma (Eriocera) cubensis (Alexander).

The female had not been described.

Female.—Length about 18 mm.; wing 15 mm.; antennae about 3 mm.

Characters as in male, differing in the sexual characters. Antennae 9-segmented. Ovipositor with the valves very long and slender, especially the cerci.

Allotype, ♀, Buenos Aires, Trinidad Mountains, Cuba, altitude 2,500–3,500 feet, May 8–14, 1936 (Darlington).

The type males had been taken in the same locality at a somewhat lower level (altitude 1,600 feet, March 24, 1925, J. G. Myers).

Hexatoma (Eriocera) juliana Alexander.

The allotopotype and paratopotype were added to the original definition (Journ. Agr. Univ. Puerto Rico, 21: 529–530; 1937) while the paper was in proof but no further data could be supplied at that time. The paratype were taken on the north side of the Pico Turquino, altitude 4,500–6,000 feet, June 18–20, 1936; the allotype at the summit, altitude 6,000 feet, June 16–21, 1936, all secured by Mr. Darlington. These specimens are smaller than the type (Male.—Length about 12 mm.; wing 12.5–13.5 mm. Female.—Length about 17 mm.; wing 15 mm.) but otherwise conform in all essential features. The antennae of the male are 8-segmented.

Hexatoma *(Eriocera)* **ornaticornis** sp. n.

Mesonotal praescutum reddish brown with four clearly defined dark brown stripes; antennae 7–segmented, basal four segments and apical third of last segment black, the remainder yellow; posterior sclerites of notum and the pleura dark brown to brownish black; halteres with brownish black knobs; femora yellow, the tips blackened; wings whitish hyaline, heavily patterned with dark brown, the areas in part ocelliform; margin of wing narrowly darkened; Rs in alignment with R_5, the basal section of the latter short; R_{2+3} short, only a little more than one-half R_{2+3+4} and subequal to R_{1+2}; *m-cu* at near one-third the length of cell *1st* M_2; basal abdominal segments yellow, darkened outwardly, the distal segments, including hypopygium, brownish black.

Male.—Length about 14 mm.; wing 11.7 mm.; antennae about 2.4 mm.

Rostrum black, sparsely pruinose; palpi black. Antennae 7-segmented; scape, pedicel, basal two flagellar segments except at incisures and distal third of terminal segment black, the remainder abruptly yellow; basal two flagellar segments more incrassated than the three outer ones; three outer flagellar segments long-cylindrical, subequal in length. Head gray; vertical tubercle moderately developed, low, on its central portion further produced into a small lobule.

Pronotum dark brown. Mesonotal praescutum reddish brown, with four clearly defined but narrow dark brown stripes, the intermediate pair ending before the suture, the lateral pair a trifle wider,

crossing the suture onto the scutal lobes; median region of scutum paler; scutellum testaceous brown, the parascutella darker; mediotergite testaceous brown, darker laterally, the pleurotergite more uniformly darkened. Pleura brownish black. Halteres with stem yellow, knob brownish black. Legs with coxae brownish blackened trochanters yellow; femora yellow, the tips conspicuosly blackened (about 1 mm. or a little more); tibiae yellow, the tips brownish black; basitarsi brownish yellow, the tips and remainder of tarsi blackened. Wings (Fig. 7) with the ground color whitish hyaline, heavily patterned with dark brown, the pattern with more or less distinct ocelli at origin of *Rs*, cord and outer end of cell *1st* M_2; two dark costal areas at end of *Sc* and at stigma, converging behind and uniting with darkening at cord; cell *C* dark brown, alternating with four smaller more yellow spots; a narrow but conspicuous brown margin from beyond stigma almost to wing-base in cell *2nd A;* a semicircular brown area across bases of cells *R* and *M* beyond arculus; brown washes in basal portions of outer radial field and in cells *M, Cu, 1st A* and *2nd A;* veins brown. Numerous macrotrichia on veins beyond cord. Venation: *Rs* longer than in *acuñai*, in alignment with R_5, the basal section of latter very short to virtually lacking; R_{2+3} short, only a little more than one-half R_{2+3+4} and subequal to R_{1+2}; cell R_3 much shorter than in *acuñai;* cell 1st M_2 relatively large, vein M_{1+2} beyond it about one-half longer than the cell; *m-cu* at near one-third the length of cell *1st* M_2, a little longer than the distal section of Cu_1. No supernumerary cross-vein in cell R_4, as in *acuñai*.

Abdomen elongate; first tergite dark brown; second segment yellow, narrowly darkened laterally, the following segments more obscure; outer segments passing through dark brown to brownish black.

Habitat.—Cuba.

Holotype, ♂, Loma del Gato, Sierra del Cobre, Oriente, altitude about 3,000 feet, July 3–7, 1935 (Darlington).

The most similar species is *Hexatoma (Eriocera) acuñai* Alexander, of western Cuba, which, while having the wing-pattern somewhat similar, differs in all details of body coloration and venation.

Hexatoma *(Eriocera)* **multiguttula** sp. n.

Mesonotum dark brown, the lateral borders of praescutum very narrowly yellow; head gray, the posterior vertex with an extensive brown area; legs black, the tips of all tibiae and the entire tarsi paling to brownish yellow; wings saturated, with a conspicuous pat-

tern of sparse brown spots and abundant dots in all the cells; R_{2+3+4} shorter than R_{2+3}; *m-cu* far distad, its caudal end more proximad than its cephalic end.

Female.—Length about 17 mm.; wing 18 mm.

Rostrum black, gray pruinose; palpi black. Antennae (female) 9-segmented; scape and pedicel obscure yellow, sparsely pruinose above; basal two flagellar segments clear light yellow; succeeding four segments more infuscated, with their apices clearer yellow; terminal segment pale basally, the outer half darkened; first flagellar segment about one-half longer than the second; terminal segment one-third longer than the penultimate. Head light gray, the posterior vertex with an extensive brown central area; vertical tubercle low.

Pronotum light yellow, the color continued backward onto the extreme lateral border of praescutum and the dorsopleural membrane to the wing-root. Mesonotal praescutum, scutum and scutellum uniformly dark brown; mediotergite dark brown, the posterior and lateral borders a trifle pale, with a delicate pale median vitta. Pleura obscure yellow, the propleura and mesopleura somewhat infumed but not forming a stripe; ventral pleurites and pleurotergite clearer yellow. Halteres with stem obscure yellow, knob dark brown. Legs with the coxae and trochanters light yellow; femora entirely black; tibiae black, the tips paling to brown; tarsi brownish yellow. Wings saturated yellow, patterned with brown, including major areas at origin of *Rs*, R_2, anterior cord and tip of vein *Cu;* all cells with abundant small brown dots; veins yellow, darker in the major clouded areas. Venation: Sc_1 ending opposite fork of R_{2+3+4}; R_2 nearly as long as R_{1+2}; R_{2+3+4} shorter than R_{2+3} but longer than the basal section of R_5; cell *1st* M_2 long, *m* only about one-third as long as the basal section of M_3; *m-cu* far distad, nearly twice its length beyond the fork of *M*, about one-third longer than the distal section of Cu_1.

Abdominal tergites obscure yellow, more darkened medially, the extreme caudal borders of the intermediate segments yellow; sternites obscure yellow. Ovipositor with long slender cerci.

Habitat.—Dominican Republic.

Holotype, ♀, Valle Nuevo, southeast of Constanza, altitude about 7,000 feet, August 1938 (Darlington).

The only generally similar species is *Hexatoma (Eriocera) cramptoni* (Alexander), known only from the Blue Mountains, Jamaica. This differs most evidently in the pattern of the thorax, unbrightened tarsi and in the details of venation, especially in the medial field,

where *m* is only a little shorter than the basal section of M_3 and *m-cu* has a different course, with the caudal end lying more distad than the cephalic portion.

Hexatoma (Eriocera) trifasciata (Röder).

Puerto Rico: El Yunque, Luquillo National Forest, June 7–10, 1935 (García Díaz). Las Mesas, near Mayagüez, over quiet pool in small stream, altitude 900 feet, November 3, 1935 (A. H. Madden).

Teucholabis (Teucholabis) myersi Alexander.

Cuba: Sierra Rangel, Pinar del Río, January 27–30, 1931 (Acuña & Otero).

Teucholabis (Teucholabis) nigrosignata Alexander.

Cuba: Buenos Aires, Trinidad Mountains, altitude 2,350–2,800 feet, May 3, 1932 (Bruner & Otero). Baracoa, Oriente, April 21–30, 1929 (Bruner & Leon Boucle).

Teucholabis (Teucholabis) portoricana Alexander.

Puerto Rico: el Semille, Villalba, altitude 1,600 feet, at light, January 26, 1935 (Hoffman).

Teucholabis *(Teucholabis)* **wighti** sp. n.

Size small (wing, ♂, under 5 mm.); general coloration yellow, the praescutum with three major polished black areas, pleura with a silvery longitudinal stripe; posterior tibiae of male with a narrow dilated ring at near three-fourths the length and a similar dilation near proximal end of posterior basitarsi; wings whitish subhyaline, the stigma and a confluent seam of cord brown; *Sc* short; R_2 interstitial with fork of *Rs;* branches of *Rs* strongly divergent; male hypopygium with apical spine of basistyle very small and weak; outer dististyle with a slender spine on mesal edge.

Male.—Length about 4.5 mm.; wing 4.8 mm.

Rostrum and palpi yellow. Antennae with scape and pedicel obscure brownish yellow, flagellum black; flagellar segments oval, decreasing in size outwardly; segments with short apical necks. Head yellow.

Pronotum yellow. Mesonotal praescutum with the ground reddish brown, with three major black areas, involving the cephalic and lateral portions of the sclerite, the latter reaching the lateral margin; scutum with lobes extensively blackened, the broad median area obscure yellow; scutellum broad, yellow, parascutella darkened; mediotergite

black, the central portion of anterior half a little paler. Pleura with the dorsal sclerites black, including the anepisternum, dorsal pteropleurite and pleurotergite; a conspicuous silvery longitudinal stripe extending from the fore coxae across the dorsal sternopleurite, ventral pteropleurite and meral region; ventral sternopleurite and dorsopleural membrane more yellowish. Halteres with stem darkened, knob light yellow. Legs with coxae and trochanters yellow; femora yellow, with a narrow brown subterminal ring, the narrow apex a trifle narrower, the darkened ring subequal in width on all legs; tibiae obscure yellow, in male with a slightly enlarged brown ring at near three-fourths the length, this provided with a group of setae; tarsi yellow, the outer segments more darkened, in male with a slightly enlarged and darkened ring near proximal end of basitarsi. Wings (Fig. 8) whitish subhyaline, the stigma and a narrow confluent seam on cord dark brown; veins pale brown. Venation: *Sc* relatively short, Sc_1 ending about opposite one-fifth the length of *Rs*; R_2 interstitial with cord, at end of *Rs*; anterior branch of *Rs* in direct alignment with the stem, the branches widely divergent so cell R_4 at margin is approximately twice as wide as cell R_2; cell *1st* M_2 closed, gently widened outwardly, shorter than vein M_{1+2} beyond it; *m-cu* shortly beyond fork of *M;* vein Cu_2 very short and pale, indicated only at base.

Abdominal tergites black, the incisures a little more reddish piceous; basal sternites yellow, transversely ringed at near midlength with dark brown; subterminal segments whitened; hypopygium abruptly black. Male hypopygium (Fig. 7) with the apical spine of basistyle, *b,* very short, weak and slender; dorsal flange long but only feebly sclerotized. Outer dististyle, *od,* with apical half a flattened blade, glabrous except on outer margin, constricted at its base and at this point on mesal edge produced into a slender spine. Crest of inner dististyle, id, high, the apex obtuse, the beak bidentate.

Habitat.—Jamaica.

Holotype, ♂, Balaclava (A. E. Wight).

Teucholabis (Teucholabis) wights is named in honor of the collector, who has taken many of the Jamaican Tipulidae now preserved in the Museau of Comparative Zoölogy. It is most nearly allied to the Cuban *T. (T.) nigrosignata* Alexander, differing especially in the narrow subterminal femoral rings, the wing pattern and venation, and the structure of the male hypopygium, especially the small weak apical spine of basistyle and the spine on mesal edge of the outer dististyle.

Gonomyia (Idiocera) angustissima Alexander.

Cuba: Soledad, April 1926 (Bequaert). San Blas, Santa Clara, Trinidad Mountains, altitude 700 feet, December 4, 1931 (Rowe).

Gonomyia (Lipophleps) bifiligera Alexander.

Puerto Rico: El Semille, Villalba, altitude 1,600 feet, at light, January 26, 1935 (Hoffman).

Gonomyia (Lipophleps) sandersi Alexander.

Cuba: Laguna Castellanos, Wojay, Havana, February 14, 1931 (Otero). The specimen, a male, has cell M_2 of both wings open by the atrophy of basal section of M_2.

Gonomyia (Lipophleps) pleuralis (Williston).

Cuba: Santiago de las Vegas, March 3, 1931 (Otero); July 12, 1930 (Bruner).

Gonomyia *(Lipophleps)* **monacantha platymera** subsp. n.

Male.—Length about 3.5 mm.; wing 3.8 mm.

Female.—Length about 5 mm.; wing 4.5 mm.

Differs from the typical form in the structure of the male hypopygium (Fig. 18). Outer spine of outer dististyle, *od,* much stouter than in either *monacanthia* or *helophila* Alexander, the apex blackened and microscopically roughened by appressed spinulae, smooth in the others; basal spine of outer dististyle a strongly blackened flange that extends into a strong spine, the outer margin of flange more or less irregularly serrate, the surface slightly scabrous. Inner dististyle, *id,* simple.

Habitat.—Cuba.

Holotype, ♂, Soledad, near Cienfuegos, August 6–20 (Banks).

Allotype, ♀, San Blas, Santa Clara, August 12, 1932 (Bates & Fairchild).

When more material becomes available, this fly will probably be accorded full specific ranking.

Erioptera (Mesocyphona) costalis Alexander.

Cuba: San Blas, Santa Clara, July 20—August 12, 1932 (Bates & Fairchild).

Erioptera (Trimicra) pilipes anomala (Osten Sacken).

Bermuda: Cavendish, January (W. S. Brooks). Swamp near Hamilton, December (W. S. Brooks).

Toxorhina (Toxorhina) domingensis Alexander.

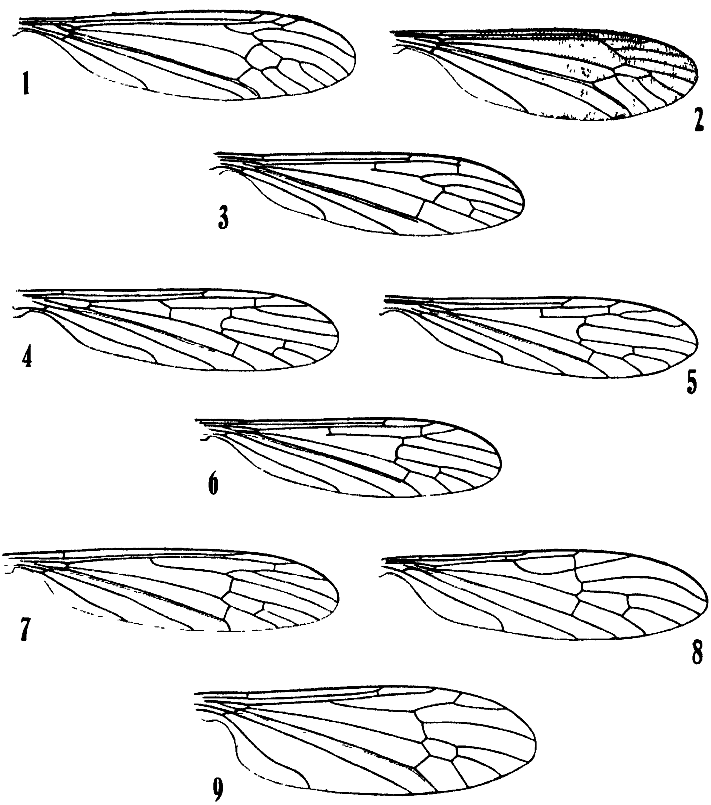
Cuba: San Blas, Santa Clara, August 20, 1932 (Bates & Fairchild).

EXPLANATION OF FIGURES

(Symbols: Male hypopygium; *a*, aedeagus; *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *id*, inner dististyle; *od*, outer dististyle; *s*, sternite; *t*, tergite; *vd*, ventral dististyle.)

Fig. 1.—**Tanypremna** *(Tanypremna)* **hodgei** sp. n., venation.
Fig. 2.—**Dolichopeza** *(Megistomastix)* **domingensis** sp. n., venation.
Fig. 3.—**Limonia** *(Limonia)* **domballah** sp. n., venation.
Fig. 4.—**Shannonomyia batesi** sp. n., venation.
Fig. 5.—**Shannonomyia haitensis** sp. n., venation.
Fig. 6.—**Shannonomyia septem-punctata** sp. n., venation.
Fig. 7.—**Hexatoma** *(Eriocera)* **ornaticornis** sp. n., venation.
Fig. 8.—**Teucholabis** *(Teucholabis)* **wighti** sp. n., venation.
Fig. 9.—**Rhabdomastix fumipennis** sp. n., venation.
Fig. 10.—**Tanypremna** *(Tanypremna)* **hodgei** sp. n., male hypopygium|
Fig. 11.—**Dolichopeza** *(Megistomastix)* **darlingtoni** sp. n., male hypopygium.
Fig. 12.—**Dolichopeza** *(Megistomastix)* **domingensis** sp. n., male hypopygium.
Fig. 13.—**Limonia** *(Limonia)* **apicata dominicensis** subsp. n., male hypopygium.
Fig. 14.—**Limonia** *(Geranomyia)* **banksiana** sp. n., male hypopygium.
Fig. 15.—**Limonia** *(Geranomyia)* **microphaea** sp. n., male hypopygium.
Fig. 16.—**Limonia** *(Geranomyia)* **sylvania** sp. n., male hypopygium.
Fig. 17.—**Teucholabis** *(Teucholabis)* **wighti** sp. n., male hypopygium.
Fig. 18.—**Gonomyia** *(Lipophleps)* **monacantha platymera** subsp. n., male hypopygium.

PLATE I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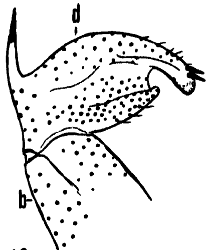

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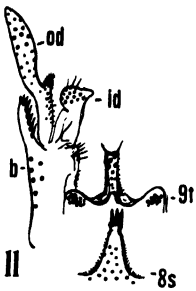

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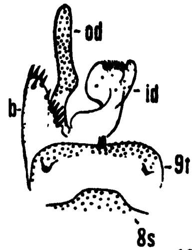

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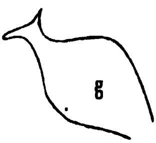

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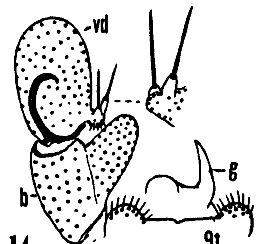

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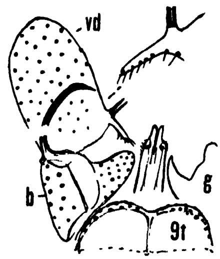

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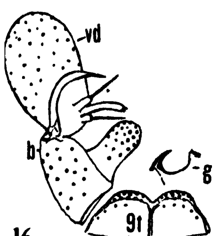

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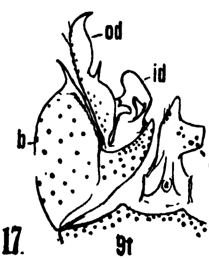

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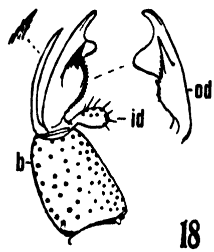

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A FARM MANAGEMENT STUDY OF 60 DAIRY FARMS IN PUERTO RICO, 1935-36[1]

By ROBERTO HUYKE

INTRODUCTION

The importance of the dairy industry in Puerto Rico from the standpoint of income as well as a source of food supply is realized by only a limited number of persons, in spite of the fact that everybody is in daily contact with its products. On account of the importance of this industry and the interest of the University in the dairy business and in the local production of foodstuffs, this study was undertaken by the Department of Agricultural Economics of this Station.

The relative economic importance of dairying as compared to certain other agricultural enterprises in Puerto Rico is shown in table 1. The total annual value of all agricultural enterprises is not shown in the table because figures on the annual production of meat and poultry products are not available.

TABLE 1. FARM VALUE OF CERTAIN CROPS AND LIVESTOCK PRODUCTS

(Based on production data obtained from the 1935 P. R. R. A * Census of Agriculture of Puerto Rico, and estimated prices)

Product	Value
Sugar cane	$37,349,896
Fruits and nuts	9,926,936
Tobacco	4,688,098
Coffee	3,102,665
Milk	2,684,777
Grains and seeds	1,941,665
Vegetables	1,773,225
Hay and forage	946,867
Cotton	49,870

[1] Thesis presented to the Graduate Faculty of the College of Agriculture of Cornell University in partial fulfillment of the requirements for the degree of Master of Science in Agriculture, 1937.

* P.R.R.A.—Puerto Rico Reconstruction Administration.

DAIRYING IN PUERTO RICO

The best dairy sections of the world are cool and fairly moist. In Puerto Rico the mean annual temperature is about 76 degrees Fahrenheit and the rainfall over most of the Island ranges from 60 inches to 120 inches per year. The temperature is too warm to favor a high production per cow. Methods of feeding and management have been inadequate. Added to these conditions is the fact that much of our native cattle stock is of a nondescript breed and the male animals have been used mainly for work purposes. For all these reasons the production of milk per cow is low. According to the 1935 Census of Agriculture, the production of milk per cow in Puerto Rico was about 1,657 pounds. This production is low as compared to about 4,500 pounds per cow in the United States and about 9,600 pounds in Holland.

However, to counteract these difficulties, dairying in the tropics has many natural and distinct advantages over other sections of the world. Expensive buildings are not required, a supply of green feed can be had all the year around, labor costs are low, and milk commands a relatively high price.

Prior to 1900, native cows were almost the only kind found on the Island. The greatest improvement in cattle breeding began in 1911 when farmers started to import Holstein-Friesian cattle. Since then, Jerseys, Guernseys, Shorthorns, and Ayrshires have also been imported. At the present time there is a predominance of these breeds on the dairy farms. The majority are Holsteins, either grades, purebreds, or crosses with the native stock.

Cows are fed green feed the year around. On most commercial dairy farms the cows are fed concentrates, usually commercial mixed rations. The dairy farmers as a rule do not grow concentrates in Puerto Rico. About the only time when cows are seen in the barn, which is of the open-shed type, is during milking, so that the majority of the time they may be seen in the open pasture. Milking is by hand.

Different kinds of soilage crops and pasture are grown in the Island, but the most important are Guinea and Para grass. In 1929, according to the Census of Agriculture, there were 12,838 acres in Guinea grass and 9,142 acres in Para grass. Besides these two, other grasses are grown such as Guatemala, Elephant, and Molasses. Of these and other grasses, there were in 1929 about 6,713 acres.

On the southern coast where rainfall is scant (20 to 40 inches annually) there are a few silos, the only ones in the Island.

In 1935, there were 61,787 cows milked on farms as compared to 78,412 cows 5 years before. The average milk production per cow in 1935 according to the Census was 1,657 pounds, as compared to about 1,600 pounds per cow in 1930. This represented a small increase of about 4 per cent in production per cow and about 21 per cent decrease in the number of cows milked in the five-year period.

In 1935, there were 284,866 cattle in Puerto Rico as compared to 310,514 in 1930. This difference represents a decrease of about 8 per cent as compared to a decrease of 21 per cent in the number of dairy cows milked. Out of the total number in 1930, there were 4,144 pure bred registered animals on farms, or about 1.4 per cent of the total.

Concentrates are mainly imported from the United States. During the fiscal year 1935–36, the value of imported feeds was $646,583, of which $643,501 came from the mainland. Besides this, $1,325,296 of dairy products from the United States and $113,699 from other countries were imported.

In spite of the fact that in 1935 there were 23,335 farms, out of a total of 52,790 farms on the Island, reporting cows milked, there were only 661 dairy farms, that is, farms in which milk was the principal source of income. According to the Department of Health there were in 1936 a total of 705 dairies of which 297 had 10 cows or less, 330 had from 11 to 50 cows, and the remainder (78) had 51 or more cows. The average number of cows per farm was 24.5 for all farms. These farms had an average production per cow about twice the amount of the average for all cows in the Island. This is to be expected for they have better cows and feed more liberally than the average farmer.

METHOD OF PROCEDURE

The survey method was used in making this study. A letter of introduction from the President of the Farmers' Association, in which their cooperation was requested, was presented to the farmers visited. Besides, the field men explained the purpose of the study to the farmers and those willing to cooperate were asked specific questions concerning their farm businesses and the answers recorded on a specially-prepared form. Each report was carefully checked and if any items were missing, another visit was made. They were

rechecked and carefully analyzed. Some records were discarded for one or more important reasons, especially for the lack of accurate information. These records were taken during the month of July 1936 and covered the farm operations from July 1, 1935 to June 30, 1936. Sixty usable records were obtained in the vicinity of San Juan and all the farms studied supplied this market or the market of Río Piedras which for practical purposes can be classified as a single market due to the proximity of the two cities.

DESCRIPTION OF THE AREA STUDIED

Location: All of the dairy farms included in this study are in the vicinity of San Juan, capital of Puerto Rico. They are located in two geographic regions, namely, the Northern Coastal Lowlands, and the Northern Foothills,[1] in the municipalities of Dorado, Toa Alta, Toa Baja, Cataño, Bayamón, Guaynabo, Río Piedras, Trujillo Alto, Carolina, and Loíza (Canóvanas). (See figure 1).

Climate: The mean annual temperature in the area studied is about 78 degrees Fahrenheit. According to data compiled from the Weather Bureau at San Juan, for 32 years including 1930, the average temperature by months fluctuated from 75 degrees Fahrenheit to 80 degrees Fahrenheit. The former temperature occurred during the months of January, February, and March, and the latter from June to October, inclusive. These data can be used to represent the area studied, for conditions in all of it are similar if not identical. Relative humidity for San Juan is around 76 to 80 per cent average during the year.

In six out of the ten municipalities visited, records of rainfall have been kept for not less than 10 years and not more than 47 years. The data compiled by the Weather Bureau at the different stations are shown in table 2.

The average yearly rainfall ranges from about 68 to 92 inches in the area studied. Rainfall is not evenly distributed throughout the year, thus accounting for the so-called wet and dry seasons. The dry season, according to the Weather Bureau, is limited to the months of January to April, inclusive, and the wet season the remainder of the year.

[1] Picó, Rafael. Studies in the Economic Geography of Puerto Rico, Univ. of Puerto Rico Bull. ser. VII—No. 1, pp. 57–78, 1937.

TABLE 2. COMPARISON BETWEEN THE LONG-TIME AVERAGE MONTHLY RAINFALL AND THE RAINFALL BY MONTHS FOR THE YEAR ENDING JUNE 30, 1936 IN THE AREA STUDIED

Month	Canóvanas		Río Piedras		Bayamón		Toa Baja		To[illegible]ta	
	Average	1935-36	Average	1935-36	Average	1935-36	Average	1935-36	Average	1935-36
1935										
July	9.09	7.07	7.57	6.98	8.05	8.69	8.08	7.80	10.48	11.06
August	8.05	9.08	7.75	7.30	8.30	10.94	6.32	8.24	10.03	15.25
September	7.46	7.99	8.23	6.00	7.96	10.12	6.73	4.41	9.82	11.10
October	7.01	8.31	6.66	6.62	6.58	16.36	5.33	6.94	7.85	9.31
November	8.77	2.92	7.14	3.86	7.42	7.18	6.82	5.93	9.08	8.71
December	7.22	2.75	6.33	1.97	6.24	2.46	5.38	0.89	7.45	0.67
1936										
January	5.64	3.75	4.70	1.58	4.77	1.68	5.57	2.55	7.36	2.94
February	3.31	1.63	3.12	1.03	3.40	1.01	3.69	1.12	4.81	1.44
March	3.84	0.59	3.61	0.88	3.81	1.52	4.37	1.01	5.10	3.88
April	4.78	1.40	4.69	1.87	4.66	4.45	3.56	1.02	4.17	1.31
May	6.95	13.41	6.77	16.11	7.59	15.77	7.14	9.10	9.71	25.76
June	6.82	6.83	6.16	5.49	7.03	6.77	4.60	1.39	6.50	4.72
Total	78.94	65.73	72.73	59.69	75.72	86.95	67.59	59.40	92.36	96.15

In general, the annual rainfall during 1935–36 was lower than the average except for two municipalities in which it was higher. The months of November to April were drier than normal, but heavy rainfall occurred during the months of May and October just before and after the dry spell.

Abundance of sunshine and a continuous growing season throughout the year are characteristic of Puerto Rico as well as of other tropical countries.

Soils and topography: The Northern Coastal Lowlands region, where most of the farms studied are located, is of level topography, and the elevation is below 250 feet above sea level. A few of the farms are located in the Northern Foothills region where the topography is hilly in nature and at elevation somewhat higher than in the Coastal Lowlands.

In spite of the fact that the area studied is a small one, there are many different soil series. Among them are the Catalina, Alonso, Colinas, Tanamá, Múcara, Río Piedras, Bayamón, Vega Alta, Lares, Fajardo, Moca, Corozo, Toa and Coloso series. These soils range from a low to a high productivity and their origin may be alluvial or derived from the tuffs and igneous rocks, limestone or shale. They range in texture from sandy to clay soils. The most productive are of alluvial origin such as the Toa and Coloso series. The Catalina, Alonso, and Múcara series which are fairly productive are derived from the tuffs and igneous rocks. The Colinas, Tanamá, and Vega Alta soils series which range in productivity from medium to low are derived from limestone. The Río Piedras soil is of a low

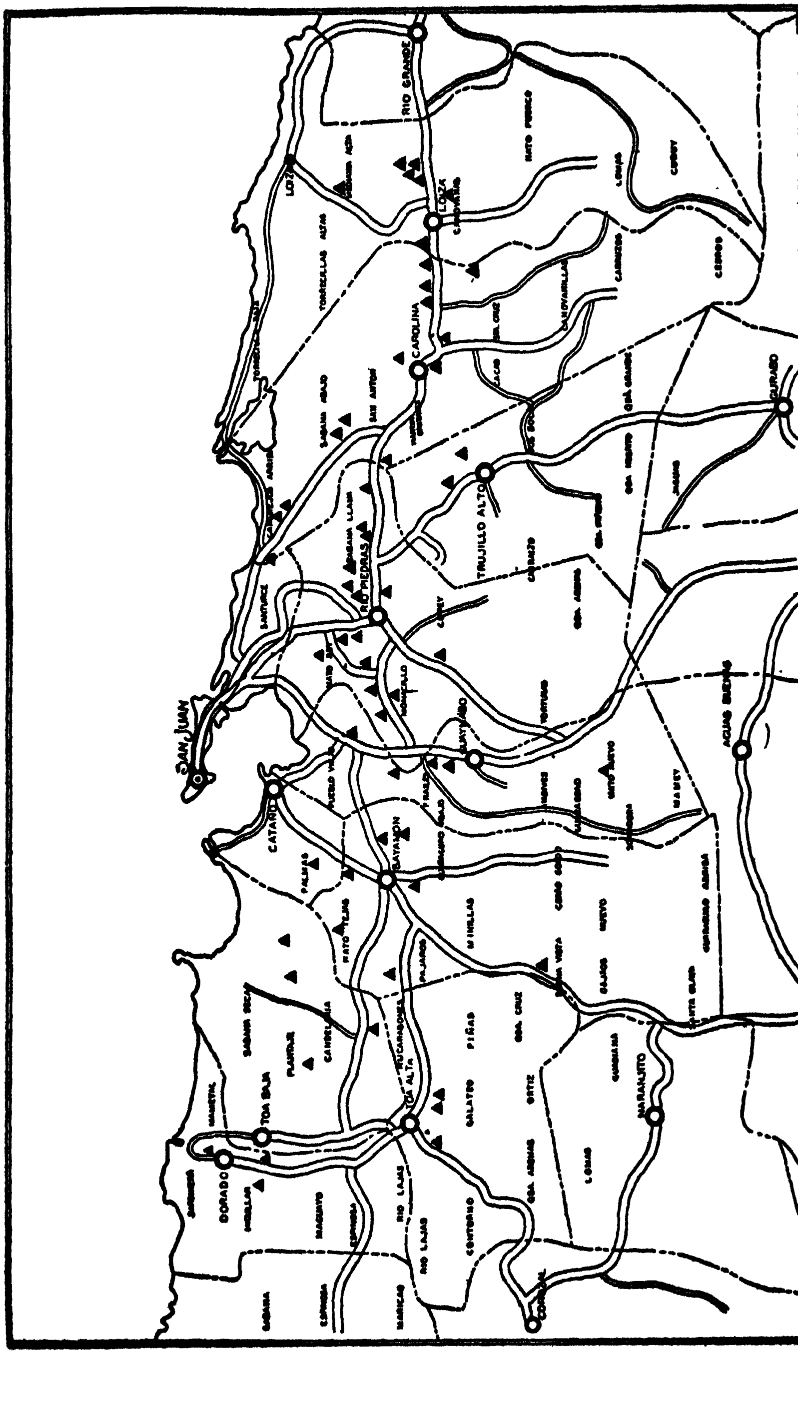

FIG. 1. Approximate location of the 60 commercial dairy farms included in the study.

productivity because of low organic matter, severe acidity, and heavy plastic physical characteristics of all layers. It is derived from shale.

Transportation facilities and markets: Transportation facilities are very good and all the farms studied were located by or very near a good road usually macadamized. The greatest bulk of the milk sold was disposed of at the markets of San Juan and Río Piedras which constitutes the most important fluid milk market in the whole Island. For practical purposes these two markets may be considered as one for they have the same city limits. In San Juan alone there were 137,215 inhabitants, and the urban population of Río Piedras was 16,849 inhabitants, out of a total of 1,723,534 in the entire Island, according to the Puerto Rico Reconstruction Administration Census of 1935. This market represented about 9 per cent of the total population of the Island.

ORGANIZATION OF THE FARMS STUDIED

The returns from the farm business are largely dependent upon the efficiency in production and upon the prices received for the product. The efficiency in the production of the product depends on two important features of the farm business, the organization and the operation. The organization relates to such items as the capital investments in the different parts of the farm business, the use of the land, the kinds and amounts of crops grown, the kinds and amounts of the livestock kept, and other items relative to the general set-up of the farm business. This section of the bulletin presents the analysis of the organization of the 60 dairy farms studied in this report.

Of the total, 29 farmers were full owners; the remainder renters. The usual agreement between the landlord and tenant is that the latter pays the former cash for the land rented and the landlord pays the taxes. The landlord does not share the expenses in running the farm business nor does he own part of the livestock.

Amount and Distribution of Farm Capital [1]

There were 29 full owners, 10 renters, and 21 owners and renters. For this reason, in this paper farm capital, is distributed according to the type of ownership or tenure.

[1] *Capital invested:* The average of the amounts at the beginning and end of the year of all farm property, land, houses, buildings, livestock, feed, seed, and equipment was considered as the capital invested in the farm business. It is also termed farm capital. Unless otherwise specified, it refers to the sum of both the landlord's and operator's capital.

The average farm capital for all farms studied was $57,976 (table 3). Of this, about 80 per cent was in real estate, 18 per cent in livestock, and 2 per cent in equipment. The total capital per *cuerda* averaged $234. The value of the land alone constituted about 72 per cent of the total capital per farm, and averaged $169 per *cuerda*.

TABLE 3. AMOUNT AND DISTRIBUTION OF FARM CAPITAL

60 DAIRY FARMS, PUERTO RICO, 1935–36

Item	Twenty-nine owner-operated farms		Ten rented farms				All 60 farms	
			Operator		Landlord			
	Average value per farm	Per cent of total	Average value per farm	Per cent of total	Average value per farm	Per cent of total	Average value per farm	Per cent of total
Operator's house	$1,753	3.2	$51	0.4	$358	1.1	$1,506	2.6
Barns	2,053	3.8	30	0.2	1,550	4.7	2,101	3.6
Other improvements	976	1.8	90	0.7	791	2.4	863	1.5
Land	40,033	73.0			30,387	91.8	42,049	72.5
Total real estate	44,815	81.8	171	1.3	33,086	100.0	46,519	80.2
Livestock	9,059	16.5	11,487	89.5	.		10,293	17.8
Equipment	937	1.7	1,173	9.2	14		1,164	2.0
Total	$54,811	100.0	$12,831	100.0	$33,100	100.0	$57,976	100.0

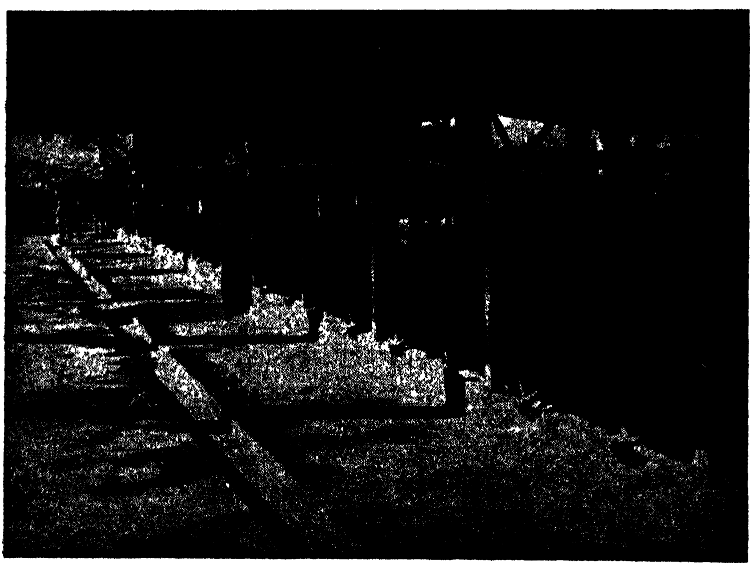

FIG. 2. Inside view of a very clean and well ventilated dairy barn with plenty of sunshine during daytime.

The value of the operator's house accounted for about 3 per cent of the capital, the barns for 4 per cent, and other buildings and real estate for 1 per cent.

A rather low investment in barns per cow is accounted for by the fact that these are of the open-shed type and there is no need of closed buildings for the protection of the cows during the winter. This amounted to about $26 per cow.

Use of Land

The 60 farms surveyed for this study had an average of about 248 *cuerdas* per farm, of which 67.2 were planted to different crops. Of these, 1.8 were intercropped and 0.3 double-cropped, leaving a net of 65.1 *cuerdas* in crops. Double-cropping and intercropping were not important on the farms studied (table 4).

TABLE 4. USE OF LAND

60 DAIRY FARMS, PUERTO RICO, 1935-36

Item	Total for all farms	Average per farm	Proportion of total area
	Cuerdas [1]	*Cuerdas* [1]	Per cent
Total in crops [2]	4,032	67.2	.
Inter-cropped	111	1.8	..
Double-cropped	17	0.3	..
Net in crops [3]	3,905	65.1	26.2
Permanent pasture	9,992	166.5	67.1
Wooded pasture	274	4.6	1.8
Woods	162	2.7	1.1
In buildings, roads, fences, etc.	442	7.4	3.0
Waste land	114	1.9	0.8
Total	14,889	248.2	100.0

[1] The *cuerda* is the unit of land measure in Puerto Rico. Equivalent to 0.9712 acres.
[2] *Total cuerdas in crops:* The total area planted to crops on a farm. It does not include permanent pasture, wooded pasture, or woods.
[3] *Net cuerdas in crops:* From the total *cuerdas* in crops were deducted the *cuerdas* inter-cropped and double-cropped, to obtain the net *cuerdas* in crops which represent the total area that was actually under cultivation.

Permanent pasture accounted for 166.5 *cuerdas* per farm or about 67 per cent of the total area. The rest of the land was devoted to wooded pasture, 4.6 *cuerdas;* woods 2.7 *cuerdas;* land occupied by buildings, roads and fences 7.4 *cuerdas;* and 1.9 *cuerdas* which were waste land entirely unfit for agriculture.

Crops

Kind of crops grown: Sugar cane was the most important crop grown, accounting for about 44 per cent of the total crop area. The next most important group of crops were the soilage crops (Para grass, Elephant grass, Guinea grass, and Guatemala grass) which

occupied 37 per cent of the crop area. Coconuts accounted for 11 per cent of the total. These three groups of crops covered 92 per cent of the total land used for growing crops. Several other crops were grown, but they were relatively unimportant and included grapefruit, corn, and sweet potatoes (table 5).

TABLE 5. KIND OF CROPS GROWN

60 DAIRY FARMS, PUERTO RICO, 1935–36

Crop	Number reporting	Area (1)	Average per farm	Per cent of crop area
		Cuerdas	*Cuerdas*	
Sugar cane(2)	31	1,711 9	28 5	43.8
Para grass	53	1,346 5	22 4	34.5
Coconuts(3)	11	431.9	7 2	11.0
Grapefruit...	8	107.6	1 8	2.8
Elephant grass	9	46 0	0 8	1 2
Corn	9	42.3	0 7	1 1
Guinea grass	6	35 5	0 6	0.9
Sweet potatoes	7	29 7	0 5	0.8
Plantains(4)	12	27 2	0 5	0.7
Yautías	12	26.5	0.4	0.7
Guatemala grass	5	17 0	0 3	0 4
Tobacco	2	13 6	0 2	0.3
Bananas	9	12 4	0 2	0.3
Dry beans	3	12 0	0 2	0.3
Cucumbers	3	12 0	0 2	0.3
Lettuce	2	7 0	0 1	0.2
Cassava	4	5.0	0 1	0.1
Other crops	12	23 4	0.4	0.6
Total..	59	3,907.5	65.1	100.0

(1) 125.0 *cuerdas* planted to garden crops by "agregados" eliminated.
(2) 82.0 *cuerdas* of sugar cane not harvested included.
(3) 30.0 *cuerdas* of coconuts not-bearing included.
(4) 18.0 *cuerdas* of plantains not-bearing included.

Of the 31 farmers reporting sugar cane, only one fed it green to the livestock. Sugar-cane tops are used very much for the feeding of livestock during the harvesting season of sugar cane (January to May). It is relished by cows and is produced during part of the dry season when there may be a scarcity of pasture.

Pasture and soilage crops: There was an average of about 191 *cuerdas* per farm in permanent pasture and soilage crops which represent 77 per cent of the total area in the farms. Of these, 167 *cuerdas* or 87 per cent were in permanent pasture and 24 *cuerdas* or 13 per cent in soilage crops (table 6).

Para grass was the most important type of grass grown. It accounted for about 37 per cent of the total area in pasture. This crop thrives very well in low and wet soils where maximum yields are obtained. As shown in table 2, the area studied is supplied with an abundant rainfall during the year, which makes it an area well adapted to the growing of Para grass. The other types of pas-

ture such as the Guinea, Molasses, Elephant, and Guatemala grasses were relatively unimportant, accounting for 5 per cent of the area in pasture. Pastures which could not be classified as in the previous sentences, mostly "Grama grass", were designated as other permanent pasture and this occupied about 58 per cent of the total area in pasture. There were 1.59 *cuerdas* of pasture per animal unit pastured of which 1.39 *cuerdas* were in permanent pasture and 0.20 *cuerdas* in soilage crops.

TABLE 6. DISTRIBUTION OF PASTURE AND SOILAGE CROPS PER FARM

60 DAIRY FARMS, PUERTO RICO, 1935-36

Kind	Soilage crops	Permanent pasture	Total per farm	Per cent of total	Cuerdas per animal unit pastured
	Cuerdas	*Cuerdas*	*Cuerdas*		
Para grass	22.4	47.8	70.2	36.8	.58
Guinea grass	0.6	6.8	7.4	3.9	.06
Molasses grass		0.9	0.9	0.5	.01
Elephant grass	0.8		0.8	0.4	.01
Guatemala grass	0.3		0.3	0.1	....
Other permanent pasture		111.0	111.0	58.3	.93
Total	24.1	166.5	190.6	100.0	1.59

FIG. 3. View of a "malojillo" soilage crop. Note its nearness to the dairy barn which can be seen on the left corner of the picture.

Crop yields: In general, the 1935–36 yields on the farms studied are below those commonly accepted in Puerto Rico as satisfactory. The high yield of Para grass for harvesting purposes was due to the fact that the best fields are used for the cultivation of this grass. Usually, soilage crops are planted near the barn where they are supplied constantly with water and manure.

Such crops as yautías and sweet potatoes are not usually harvested at once and this makes it more difficult for the farmers to estimate the yields; which may account for the low production per *cuerda* of these crops.

Sugar-cane yields are about the average. This may be explained by the fact that the greatest portion of the sugar cane was a ratoon crop which has lower yields than both the "primavera" and "gran cultura" plantings. Average yields for other crops are shown in table 7.

TABLE 7. AVERAGE YIELD PER CUERDA OF THE PRINCIPAL CROPS

60 DAIRY FARMS, PUERTO RICO, 1935–36

Crop	Unit	*Cuerdas* harvested per farm	Yield per cuerda
Sugar cane	Tons	28.5	26.5
Coconuts	Thousands	7.2	[illegible]1.4
Para grass	Tons (green)	22.4	(1) 25.1
Grapefruit	Thousands	1.8	4.8
Corn	Hundredweight	0.7	5.7
Sweet potatoes	Hundredweight	0.5	16.7
Plantains	Thousands	0.5	12.4
Yautías	Hundredweight	0.4	24.9
Tobacco	Hundredweight	0.2	6.2
Bananas	Thousands	0.2	27.8
Dry beans	Hundredweight	0.2	1.4
Cucumbers	Boxes	0.2	225.0

(1) Data are for 11 farmers only, who had some basis for estimating the production.

Livestock

Kinds and amounts of livestock: Statements of the inventories, sales, and purchases are given in table 8. There was an average of about 121 animal units[1] per farm on the 60 dairy farms studied. Of this number 95 per cent were in cattle. Cows were 67 per cent of the total animal units on all farms.

[1] *Animal unit:* Animal unit is a measure of the average number of animals kept on a farm during a year, based on the amount of feed consumed and value of manure produced. A mature cow, bull, horse, mule, two head of young stock, or 100 hens are each considered as one animal unit.

Poultry was kept on only 29 of the 60 farms studied. This can be explained by the fact that only 32 farmers lived at the farm. In similar studies made by the Division of Agricultural Economics of the Agricultural Experiment Station of the University of Puerto Rico, it has been shown that the majority of the farms keep a number of hens for the supply of eggs for home use (Bulletin No. 43, "A Farm Management Study of Small Farms in Two Areas of Puerto Rico", by J. E. McCord, S. L. Descartes, and R. Huyke).

Value per head: Of the total farm capital, about 18 per cent or $10,293 per farm was invested in livestock. The value of important livestock at the end of the year is shown in table 9. The highest value per head was for the bulls, amounting to $140 and next for the cows at $98 per head. Heifers 2 years old or over not fresh, work oxen, stallions and mules were valued at about the same rate, or about $50 per head.

TABLE 8. KINDS OF LIVESTOCK, INVENTORIES AND VALUES

60 DAIRY FARMS, PUERTO RICO, 1935–36

Type of livestock	Animal Units	Beginning of year			Purchases			Sales			End of year		
		No. of farms reporting	Total number	Total value	No. of farms reporting	Total number	Total value	No. of farms reporting	Total number	Total value	No. of farms reporting	Total number	Total value
				Dollars			Dollars			Dollars			Dollars
Cows	4, 829. 50	60	4, 564	438, 951	24	475	42, 345	50	607	23, 115	60	5, 095	498, 372
Heifers 2 years old	634. 00	58	1, 642	80, 231	3	32	1, 390	7	35	1, 449	48	894	46, 100
Heifers 1 year old	404. 50	54	820	13, 446				3	9	179	54	798	23, 956
Heifers under 1 year	282. 50							11	127	397	57	1, 130	12, 467
Male calves less than 1 yr.	51. 50				1	1	25	39	955	1, 542	32	206	1, 549
Male calves 1 year & over	43. 50	22	99	1, 513	2	3	86	7	21	384	21	75	1, 831
Bulls	120. 00	55	118	15, 987	10	12	1, 855	7	7	237	58	122	17, 106
Work oxen	555. 00	56	557	27, 981	8	32	1, 573	10	31	1, 579	57	553	26, 558
Stallions	173. 50	47	176	9, 005	1	1	36	2	3	85	46	171	8, 960
Mares	71. 50	30	72	1, 570	1	1	10	1	1	20	31	71	1, 500
Colts	8 00										8	32	270
Mules	14. 50	7	14	780	1	1	30				8	15	810
Jackasses	7. 00	2	7	58							2	7	58
Boars	1. 70	6	8	160	1	1	14	1	1	35	7	9	175
Brood sows	10. 60	19	59	933				3	10	201	16	47	834
Small pigs	3. 80				1	1	1	7	143	409	8	76	242
Hogs	7. 60	11	32	380	6	15	43	12	65	835	15	44	407
Sheep and lambs	5. 79	3	40	139							3	41	142
Goats and kids	3. 54	5	16	52	2	19	149				7	31	201
Hens	10. 40	29	1, 120	777	1	6	3	4	61	38	29	960	642
Cocks	1. 46	29	115	198	1	1	1				29	177	335
Pullets	3. 44	12	343	112				1	30	6	17	345	129
Cockerels	3 06	10	345	104				2	102	29	13	267	91
Other fowls	0 79	6	50	48	1	2	1	1	4	8	7	65	58
Total	7, 247. 18			$592, 425			$47, 562			$30, 548		....	$642, 793

TABLE 9. VALUE OF IMPORTANT ANIMALS AT THE END OF THE YEAR

60 DAIRY FARMS, PUERTO RICO, 1935–36

Type	Number of farms reporting	Value per head
Cows	60	$98
Heifers 2 years old	48	52
Heifers 1 year old	54	30
Heifers under 1 year	57	11
Male calves under 1 year	32	8
Male calves 1 year and over	21	24
Bulls	58	140
Work oxen	57	48
Stallions	46	52
Mares	31	21
Mules	8	54
Brood sows	16	18
Hens	29	0.67
Cocks	29	1.89

Monthly statement of cow numbers and replacements: The monthly inventory of cows, including purchases, sales, deaths, heifers and cows freshening and size of herd are shown in table 10.

TABLE 10 INVENTORY OF COWS

60 DAIRY FARMS, PUERTO RICO, 1935–36

Year and month	Purchases	Sales	Deaths	Heifers freshening	Size of herd	Cows freshening
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
1935						
July	100	54	3	33	4,564	196
August	90	33	2	47	4,640	219
September	7	57	5	52	4,742	271
October	7	37	3	63	4,739	306
November	72	29	1	66	4,739	276
December	12	55	7	64	4,877	292
1936						
January	30	62	7	66	4,891	267
February	42	53	9	68	[illegible]	276
March	24	75	13	75	4,966	309
April	29	54	10	81	4,977	339
May	23	31	7	71	5,023	318
June	39	67	9	53	5,079	262
Total	475	607	76	739	5,095	3,331

The dairy men increased the size of their dairy herds during the year as evidenced by the figures in table 8. The average number of cows per farm at the beginning of the year was about 76 and at the end it was 85, an increase of 9 cows per herd. The average number[1] of cows per farm for the year was computed to be 81. About 84 per cent of the average number of cows per farm freshened during the year. About 11 per cent of the average number of cows

[1] *Number of cows:* The average number of cows on the farm during the year based on the thirteen-month inventory was used.

died or were sold during the year. Thus the replacement of cows was about 11 per cent for the year.

Age of cows: Of the 5,095 cows on farms at the end of the year 96.1 per cent were from three to ten years of age. Below this range were 2.1 per cent and above it only 1.8 per cent (table 11).

TABLE 11. AGE OF COWS

60 DAIRY FARMS, PUERTO RICO, 1935-36

Age of cows	Total number	Per cent of total
2 years old	107	2.1
3 years old	672	13.2
4 years old	1,115	21.9
5-10 years old	3,108	61.0
Over 10 years old	93	1.8
Total	5,095	100.0

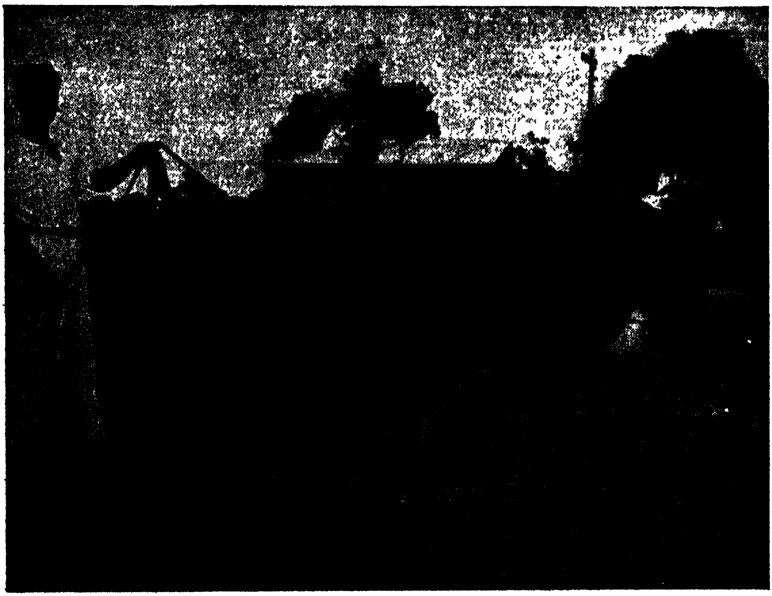

FIG. 4. Holstein cow (15/16) born and reared in Puerto Rico, which produced 13,300 pounds of milk during a year. Notice the splendid development of the udder.

Breed of cows and bulls: Farmers were asked the breeds of the cows they had at the end of the year. Cows having 50 per cent or more blood of one of the recognized breeds were classified as such. There existed a great predominance in Holstein-Friesian cows which

accounted for 78.5 per cent of the total. Guernseys accounted for 8.3 per cent; Jerseys for 6.8 per cent; Shorthorns for 0.9 per cent; Ayrshires for 0.3 per cent and native cows for 5.2 per cent. In this area results indicate that where milk production is the main purpose of the farm business, Holstein cows are expected to be the most important single breed of cows. Since the importation of well-known breeds, native cows have decreased in importance, due to the low-milk production per cow. They have been used for crossing purposes with other breeds of dairy cattle especially Holstein-Friesian.

TABLE 12. BREED OF COWS

60 DAIRY FARMS, PUERTO RICO, 1935–36

Breed	Total number	Per cent of total
Native	268	5.2
Holstein	3,999	78.5
Guernsey	422	8.3
Jersey	348	6.8
Shorthorn	44	0.9
Ayrshire	14	0.3
Total	5,095	100.0

There were 122 bulls at the end of the year of which only 27 were purebred and registered. Of these 18 were Holstein bulls, 8 Guernsey and 1 Jersey. Of the 95 grade bulls, 82 were Holstein, 6 were Guernseys, 4 Jerseys, 2 Zebu and 1 Brown Swiss. Of the total number of bulls, 82.0 per cent were Holstein and 11.5 were Guernseys. There was 1 bull which was a crossbred between Holstein and Guernsey, and another one between a Holstein and Brown Swiss.

TABLE 13. BREED OF BULLS

60 DAIRY FARMS, PUERTO RICO, 1935–36

Breed	Purebred	Grades	Total	Per cent of total
	Number	*Number*	*Number*	
Holstein	18	82	100	82.0
Guernsey	8	6	14	11.5
Jersey	1	4	5	4.1
Zebu (Brahama)		2	2	1.6
Brown Swiss		1	1	0.8
Total	27	95	122	100.0

Zebu bulls were kept for the purpose of having their male progeny utilized for work purposes.

Farmers were asked about their preference of breeds of dairy cows. About 75 per cent of them preferred cows with Holstein blood.

FIG. 5. Splendid purebred Holstein specimen reared in Puerto Rico.

FARM RECEIPTS, EXPENSES, AND NET RETURNS

The principal receipts from these 60 farms were from the sales of milk, sugar cane, coconuts, and cucumbers. The major expenses were for labor, feed purchases, taxes, buildings, fertilizers, and machinery.

Farm Receipts

Crop sales: The total receipts from the sale of crops in the 60 dairy farms amounted to $215,643 or an average of $3,594 per farm. Of this, $3,264 per farm or about 91 per cent was solely from sugar cane; $158 or 4 per cent from coconuts; $58 or 2 per cent from cucumbers and $49 or 1 per cent from grapefruit. The receipts from the crops mentioned above amounted to $3,529 per farm or 98 per cent of the total. Other crops sales amounted to $65 per farm or 2 per cent of the total. (See table 14.)

Of the 60 farms studied, 43 reported sales of crops of which 30 reported sales of sugar cane. When this is taken into consideration the crop sales per farm reporting crops sold has increased to $5,015 per farm.

In so far as the value per *cuerda* harvested of the different crops is taken into consideration, there were five crops of major importance. These were tomatoes, cucumbers, sugar cane, lettuce, and pumpkins. All of these crops had sales per *cuerda* harvested amounting to at least $100 and up to $297. It is interesting to note that four of the five crops were vegetables.

TABLE 14. CROP SALES

60 DAIRY FARMS, PUERTO RICO, 1935-36

Item	Number of farms reporting sales	Value of total sales	Per cent of total	Value per farm (all farms)	Value per farm reporting sales	Value per *cuerda* harvested
Sugar cane (1)	30	$195,834	90 8	$3,264	$6,528	$122
Coconuts	8	9,501	4.4	158	1,188	24
Cucumbers	3	3,475	1.6	58	1,158	290
Grapefruit	5	2,929	1 4	49	586	27
Tobacco (1)	2	883	0 4	15	442	65
Lettuce	2	738	0 3	12	369	105
Plantains	6	707	0.3	12	118	77
Yautías	7	353	0 2	9	79	21
Tomatoes	2	235	0.1	4	118	297
Sweet potatoes	3	164	0 1	3	55	6
Bananas	2	145	0 1	2	72	12
Onions	1	125	0.1	2	125	42
Pumpkins	1	100	0 1	2	100	100
Corn	3	76		1	25	2
Other crops	6	178	0 1	3	30	8
Total	43	$215,643	100 0	$3,594	$5,015	$94

(1) Benefit payments for sugar cane and tobacco from the Agricultural Adjustment Administration not included (see table 17).

In general, the northern coast of the Island is a sugar-cane producing area. The topography is level and soils are of good productivity which may be utilized to a better advantage in growing sugar cane which is an intensive crop and more profitable than the majority if not all of the crops raised in the Island. Several sugar mills or centrals are located in the area studied.

Of the total crop production only $30 worth of products were consumed per farm.

Milk sales: The milk sold per farm amounted to 125,341 quarts of which 60,817 quarts or about 48 per cent were sold during the months of July to December inclusive. Milk sales during the year were fairly uniform. The highest milk production came in during the spring and summer months, or in other words, during the rainy season and consequently, abundance of green pasture. The comparatively low production during the dry season was offset by a higher price and so the receipts from milk sales were fairly uniform, although somewhat higher in the fall and winter months.

The cows and heifers freshening during the year per farm was about the same for the two periods from July to December inclusive and January to June inclusive. Although somewhat higher in the latter period the difference is not significant.

The average milk sales per farm amounted to $11,958 or 66 per cent of the total receipts (table 15).

TABLE 15. DISTRIBUTION OF MILK PRODUCTION

60 DAIRY FARMS, PUERTO RICO, 1935-36

Year and month	Milk sold per farm					Average price	Cows & heifers freshening per farm
	Quarts	Per cent	Per cent Nov. = 100*	Value	Per cent		
	Number					*Cents*	
1935							
July	10,341	8.2	106	$922	7.7	8.9	3.8
August	10,314	8.2	105	944	7.9	9.2	4.4
September	10,024	8.0	102	919	7.7	9.2	5.4
October	10,072	8.0	103	962	8.1	9.6	6.2
November	9,781	7.8	100	969	8.1	9.9	5.7
December	10,285	8.2	105	1,016	8.5	9.9	5.9
Total	60,817	48.4	.....	$5,732	48.0	9.4	31.4
1936							
January	10,372	8.3	106	1,032	8.6	9.9	5.5
February	9,716	7.8	99	984	8.2	10.1	5.7
March	10,628	8.5	109	1,068	8.9	10.0	6.4
April	10,470	8.4	107	1,033	8.6	9.8	7.0
May	11,555	9.2	118	1,065	8.9	9.2	6.5
June	11,783	9.4	120	1,047	8.8	8.9	5.3
Total	64,524	51.6	....	6,226	52.0	9.6	36.4
Grand Total	125,341	100.0	....	$11,958	100.0	9.5	67.8

* The per cent of the milk sold each month compared with November as a base period.

Of the 125,341 quarts of milk sold per farm, 75,114 quarts or 60 per cent was sold wholesale and the remainder, 50,227 quarts or 40 per cent retailed. The average price received by the farmer was 7.9 cents per quart for the milk sold wholesale and 12.0 cents per quart for the milk retailed. The average price for the total milk sold was 9.5 cents per quart. Although about 20 per cent more milk was sold wholesale, the value for this milk was a little less than that sold retail due to the difference in price of milk. Milk sales accounted for 99.9 per cent of the receipts from livestock products sold.

Egg sales: Only $7 worth of eggs were sold per farm, or 0.1 per cent of the total receipts from livestock products sold, at an average price of 32.3 cents per dozen.

TABLE 16. SUMMARY OF LIVESTOCK PRODUCTS PER FARM

60 DAIRY FARMS, PUERTO RICO, 1935-36

Item	Product (Quantity)	Price (Cents)	Value	
			(Dollars)	(Per cent)
Milk wholesale	75,114 qts	7.9	5,945	49.7
Milk retail	50,227 qts	12.0	6,013	50.2
Total milk	125,341 qts	9.5	11,958	99.9
Eggs	21 doz.	32.3	7	0.1
Total			11,965	100.0

Miscellaneous receipts: In addition to the income from sale of crops, livestock and livestock products, most farms had some miscellaneous source of income. The total income from these miscellaneous sources amounted to $22,869 or an average of $381 per farm (table 17). Of these, $239 was what the farmer received as benefit payments from the Agricultural Adjustment Administration for sugar cane and $4 for tobacco. Farmers sold seedlings for an average of $46 per farm, as well as succulents (Para grass) for an average of $26 per farm. Some pasture land was rented to other farmers for which an average rent of $15 per farm was received. Empty sacks were sold for a value of $15 per farm and equipment and fence posts for $14 per farm each. Other miscellaneous receipts were unimportant.

TABLE 17. MISCELLANEOUS RECEIPTS

60 DAIRY FARMS, PUERTO RICO, 1935-36

Item	Number of farms reporting	Average per farm	Average per farm reporting
A. A. A. payments for sugar cane	29	$239	$494
Sale of seedlings	6	46	464
Succulents sold	4	26	394
Pasture rent	2	15	450
Empty sacks	35	15	25
Sale of equipment	4	14	206
Fence posts	1	14	816
A. A. A. payments for tobacco	2	4	132
Wood	2	2	70
Hauling milk	1	2	130
Charcoal	1	2	125
Hauling sugar cane	1	1	55
Rent of house on farm	1	1	36
Animal labor off farm	1	......	10
Total	54	$381	$422

Farm privileges: Farm privileges include what the farmer received from his farm besides his labor income. The yearly rental value of the farm house, plus all the farm and livestock products obtained during the year constituted the farm privileges. The value

of the farm privileges for all farms studied averaged $479 (table 18).

Milk used in the household accounted for the major part of the privileges ($235). Next in importance was the yearly rental value of the dwelling or farm house, which averaged $172. Minor produce, which included bananas, sweet potatoes, and other minor crops, averaged $30 per farm. Livestock consumed by the household averaged $21 and eggs $19 per farm. The farm privileges, when added to the labor income, represented the labor earnings of the farmer. The average labor earnings for all the farms studied averaged $3,048 per farm. (See table 21.)

TABLE 18. FARM PRIVILEGES

60 DAIRY FARMS, PUERTO RICO, 1935-36

Item	Average per farm	
	Value	Quantity
Milk	$235	2,535 quarts
Eggs	19	75.6 dozens
Livestock	21	
Minor produce	30	
Dwelling	172	
Charcoal	1	
Other	1	
Total	$479	

Farm Expenses

General operating expenses: The total farm expenses included the cash farm expenses incurred by the operator and landlord and unpaid labor excluding value of the rent.

The average farm expenses for all farms amounted to $9,859 table 19). Of this amount, about 38 per cent was spent for labor; 28 per cent for cattle feed; and 8 per cent for taxes. These three items amounted to $7,261 per farm or 74 per cent of the total farm expenses. Other expenses averaged $2,598 per farm or 26 per cent of the total.

Labor was the most important item of expense on these farms averaging $3,733 per farm. Out of this total, $2,023 was paid to monthly and weekly labor, and $1,540 to day labor. The average unpaid labor amounted to $53 per farm and the labor compensation insurance averaged $117 per farm.

Cattle feed bought was the second most important item of expense, amounting to $2,792 per farm or about 28 per cent of the total expenses. There were two farmers who did not buy any cattle feed.

Other feeds were bought mainly for poultry and this averaged $26 per farm.

TABLE 19. EXPENSES PER FARM

60 DAIRY FARMS, PUERTO RICO, 1935-36

Item	Farms reporting	Amount	
		Dollars	Percent
Monthly and weekly labor	60	2,023	20.5
Day labor	57	1,540	15.6
Unpaid labor	5	53	0.6
Labor compensation insurance	55	117	1.2
Total labor costs	60	3,733	37.9
Cattle feed	58	2,792	28.3
Other feed	27	26	0.3
Fertilizers	36	383	3.9
Repairs for buildings	44	278	2.8
New buildings	10	302	3.1
Machinery repairs	53	69	0.7
New machinery	50	364	3.7
Farm share auto	23	86	0.9
Farm share truck and bus	22	268	2.7
Horseshoeing	43	11	0.1
Taxes	60	736	7.5
Fences	48	77	0.8
Gas and oil	21	43	0.4
Electricity	48	161	1.6
Ice	3	21	0.2
Advertising	3	16	0.2
Veterinary service and medicine	59	43	0.4
Disinfectants	60	21	0.2
Transportation of produce	11	43	0.4
Caps, etc.	55	157	1.6
Water	13	17	0.2
Marketing expenses in milk stores	2	70	0.7
Telephone	7	10	0.1
Transportation of milk	1	28	0.3
Other expenses	57	104	1.0
Total	60	(1) 9,859	100.0

(1) Includes unpaid labor, landlord's expenses, and operator's expenses excluding rent.

Taxes averaged $736 per farm or 7.5 per cent of the total farm expenses and 1.27 per cent of the average farm capital per farm.

Cash expense for fertilizers averaged $383 per farm, and $638 per farm reporting. The fertilizer bought was applied mainly to sugar cane.

The expense for construction and repairs of buildings averaged $580 per farm or 5.9 per cent of the total farm expenses. New buildings were constructed on ten farms at an average cost of $302.

New equipment and machinery repairs averaged $433 per farm.

Feed purchases: Feeds purchased averaged $2,792 per farm, of which $2,437 or 87 per cent of the total expenses for feeds was spent in concentrates, mainly commercial rations such as Larro and Michigan State rations. The average price paid per ton for these was $41.08. Two farmers did not report any feed bought during the year.

Succulents purchased averaged $223 per farm or 8 per cent of the total feed expenses. Beet pulp accounted for $213 per farm of the succulents purchased, and cane tops and pasture, mainly Para grass, for $5 per farm each.

Purchases of molasses averaged $88 per farm, salt and mineral mixtures $21 per farm, and calf meals $21 per farm. Only five farmers reported purchases of calf meals or $248 per farm reporting, and two farmers purchased skimmed milk which averaged $2 per farm or $63 per farm reporting.

It is well to note the high prices which farmers have to pay for feed in Puerto Rico. With such high prices for feed it is important to obtain high productions of milk per cow.

TABLE 20 FEED PURCHASES

60 DAIRY FARMS, PUERTO RICO, 1935–36

	Farms reporting	Total quantity	Price	Value per farm	Percent of total
Total succulents	28			$223	8.0
Beet pulp	26	6,689 cwt	$1.91	213	7.6
Cane tops	1			5	0.2
Pasture	3	10,230 bun	0.03	5	0.2
Concentrates	58	71,192 cwt	2.05	2,437	87.3
Molasses	24	76,170 gal.	0.07	88	3.1
Salt and mineral mixtures	28	960 cwt	1.33	21	0.8
Calf meals	5	490 cwt	2.53	21	0.7
Skimmed milk	2	12 cwt	10.5[illegible]	2	0.1
Total	58			$2,792	100.0

Summary of Receipts, Expenses, and Financial Returns

Labor income is one of the most generally accepted measures of the business success of a farm. In this paper it is the net farm income less interest at 8 per cent on the average farm capital. It represents what the farmer received for his year's work and management, in addition to having a house to live in and products furnished by the farm, after allowing interest at 8 per cent on his capital invested in the farm business. It is somewhat comparable to the cash wages of a married hired man on a farm, who also receives the use of a house and farm products.

The average *total receipts* * per farm were $17,859, most of which were derived from the livestock products sold, especially milk (table

* *Receipts:* Total farm receipts or gross income include: (1) the amount received for all crops sold plus the value of the crops at the end of the year which were to be sold; (2) the amount received from the sale of livestock; (3) the amount received from livestock products sold; (4) the amount received from miscellaneous sources, such as work off the farm and rent of farm buildings, etc.; (5) the amount by which the farm capital at the end of the year exceeded that at the beginning. Unless otherwise stated, it refers to the sum of both the landlord's and the operator's receipts excluding rent.

21). Milk alone averaged $11,958 per farm. Crop sales accounted for $3,594 per farm and livestock sold during the year averaged $509. The miscellaneous receipts averaged $381 per farm. The increase in capital was larger than the decrease, resulting in a net increase of $1,410 per farm, which was considered as a receipt.

The average *total expenses* ** per farm were $10,652. Of these, $9,806 per farm were represented by the farm cash expenses and $793 per farm for the livestock bought during the year. The value of the unpaid family labor as estimated by the farmer was also included as an expense, since that would have been the approximate cost of hiring the work done. This item averaged $53 per farm.

TABLE 21. SUMMARY OF RECEIPTS, EXPENSES, AND FINANCIAL RETURNS

60 DAIRY FARMS, PUERTO RICO, 1935–36

	Average per farm		
	Operator	Landlord	Total
Receipts:			
Crops sold	$3, 573	$21	$3, 594
Livestock sold	509		509
Livestock products sold	11, 965		11, 965
Miscellaneous	379	2	381
Net increase in inventory	1, 429		1, 410
Rent of farm		643	
Total	$17, 855	$666	$17, 859
Expenses:			
Farm expenses	$9, 591	$215	$9, 806
Livestock bought	793		793
Unpaid labor	53		53
Rent of farm	643		
Net decrease in inventory		19	
Total	$11, 080	$234	$10, 652
Farm income	$6, 775	$432	$7, 207
Interest at 8%	3, 648		4, 638
Labor income	3, 127		2, 569
Labor earnings	3, 607		3, 048
Return on capital	5, 402		5, 834
Per cent return on capital	11 8	3. 5	10. 1
Net cash income	$5, 399		$5, 860

The average total receipts exceeded the average total expenses on these farms by $7,207. This was the *farm income,* or the amount which the operator received for his year's work and management and for the use of the capital invested. In order to put all farms on a

** *Expenses:* Expenses include all farm business expenses. In order to put all farms on a comparable basis, the value of the unpaid family labor except that of the operator himself, was charged as an expense at what it would have cost to hire the work done. Value of livestock purchases, of new equipment or buildings and repair of buildings and equipment, were also included as expenses. When the farm capital at the end of the year was less than that at the beginning, this decrease in inventory was included as an expense. Household or personal expenses were not included. Unless otherwise stated, it refers to the sum of the landlord's and operator's expenses excluding rent.

comparable basis, regardless of mortgage indebtedness, 8 per cent interest on the average capital invested was deducted from the farm income to obtain the labor income.

The average labor income on these farms was $2,569 per farm. This means that, on the average, these farmers after deducting all business expenses and interest on investment from the total receipts received $2,569 for their year's work and management.

A farmer's labor income might be nothing, or even less than nothing, as was the case with 16 farmers who had negative labor incomes, and yet have enough net income for a living. If the farm income were $800 and the capital invested were $20,000, the labor income would be $800 less 8 per cent on the $20,000 capital ($1,600), or minus $800. However, if he had no mortgage nor any other debt, the farmer would have $800 on which to live. If he had a son working at the farm who was not paid wages, but whose time was included in the expenses as $200, the family would then have had $1,000. The farmer might thus be living well, in spite of having a negative labor income.

Labor earnings is the labor income plus the value of the farm privileges. The average value of farm privileges per farm (table 18) was $479, which when added to the labor income resulted in an average labor earnings of $3,048 per farm.

The *return on capital* is calculated by subtracting the value of the operator's time, as estimated by the farmer, from the farm income. The farm income, as already stated, represents the amount the operator received for his year's work and the use of his farm capital. By subtracting the estimated value of the operator's time from the farm income, the return on his capital invested is obtained. The average return on capital for these farms was $5,834.

The *per cent return on capital* is the return on capital expressed as a percentage of the average farm capital. These farmers had an average of $57,976 invested in their farm businesses. The return on this capital averaged $5,834 or 10.1 per cent of the capital.

From the farm income, unpaid labor was added and the increase in inventory was subtracted, the resulting figure being the *net cash income* which averaged $5,860 per farm. This figure represents the amount which the farmer had to meet the necessities of life. Interest on indebtedness was not taken into consideration.

Capital turnover is the number of years required for receipts to equal capital. An average of 3.2 years, as obtained from these dairy farms, indicates a rapid capital turnover during the year 1935–36.

FACTORS AFFECTING FARM EARNINGS

The object of this section is to ascertain the factors associated with financial success in farming. It has been found that returns from farming vary considerably from farm to farm within a given group. It is, therefore, important to find out why some farmers make and others lose money.

For this purpose, farms were sorted on different factors in three groups; each one including 20 farm records. However, the success or failure of a farm business is not normally determined by a single factor but rather by a combination of many factors. Farms were sorted on the basis of being above average in a single factor and then subsorted for two, three and more factors above the average at the same time.

These combinations of factors are especially significant from the farmer's point of view, because on any farm it is the proper combination of these factors and the relative attention given to each one that will ultimately determine the success or failure of that farm. A good farm organization should excel not only in the individual factors but in the proper combinations in order to obtain as favorable a financial return as possible. Results of these sorts are presented in subsequent tables (tables 22 to 32).

Relation of Size of Business to Farm Earnings

Total "cuerdas" in farm: One-third of the farms were small with an average of 69 *cuerdas*. The average labor income for this group of farms was $1,137. These farms had an average of 37 cows, 24 net *cuerdas* in crops, and their farm capital was $23,933 (table 22).

The middle-third group had an average of 192 *cuerdas* per farm and $1,847 of labor income. This group had an average of 73 cows, 62 net *cuerdas* in crops and $43,908 in capital.

For the large farms the average size was 484 *cuerdas* and their average labor income $4,723. They had 133 cows, 109 net *cuerdas* in crops and an average farm capital of $106,088.

The relation existing between total *cuerdas* per farm and labor income indicated that as the size of farm increased, the number of cows, net *cuerdas* in crops, capital invested and labor income increased. The only two factors which did not show a consistent increase with increase in size of farm were net *cuerdas* in crops per man and animal units per man. Although the net *cuerdas* in crops

per man increased in the second group and then decreased, this may tend to show that the efficiency decreased but this might be explained if it is taken into consideration that the third group has a greater proportion of the net *cuerdas* in crops in sugar cane.

TABLE 22. RELATION OF TOTAL CUERDAS IN FARM TO FARM EARNINGS AND OTHER FACTORS

60 DAIRY FARMS, PUERTO RICO, 1935-36

Item	Total cuerdas in farm			
	Lower third	Middle third	Upper third	Average
	Average per farm			
Number of farms	20	20	20	60
Total *cuerdas* in farms	69	192	484	248
MEASURES OF FARM EARNINGS:				
Labor income	$1,137	$1,847	$4,723	$2,569
Labor earnings	$1,600	$2,215	$5,330	$3,048
Return on capital	$2,290	$4,037	$11,174	$5,834
Per cent return on capital	10	9	11	10
SIZE OF BUSINESS:				
Net *cuerdas* in crops	24	62	109	65
Number of cows	37	73	133	81
Animal units	55	111	196	121
Man equivalent (1)	6	11	24	14
Capital invested	$23,933	$43,908	$106,088	$57,976
Gross receipts	$7,937	$14,333	$31,879	$18,050
DIVERSITY OF BUSINESS:				
Receipts from sugar cane	$1,090	$2,422	$6,996	$3,503
Value of milk sales	$5,393	$9,220	$21,261	$11,958
Per cent receipts from sugar cane were of total	14	17	22	19
LABOR EFFICIENCY:				
Net *cuerdas* in crops per man	3.8	5.6	4.5	4.7
Animal units per man	8.7	9.9	8.1	8.7
OTHER FACTORS:				
Milk sales per cow	$146	$126	$160	$147
Cuerdas in sugar cane	7	19	54	27
Percent of land in permanent pasture	58	59	72	67

(1) *Man Equivalent*: The average number of persons working on a farm during a year reduced to an adult male basis was termed the man equivalent. It is obtained by adding the total months of labor on the farm, including 12 months for the operator and dividing by 12.

Number of cows: The average number of cows per farm in the lower-third group was 30 cows. This group had an average labor income of $2,012. They handled 5,400 quarts of milk per man and sold 1,392 quarts of milk per cow at an average price of 10 cents for a total of $140.

TABLE 23. RELATION OF NUMBER OF COWS TO FARM EARNINGS AND OTHER FACTORS

60 DAIRY FARMS, PUERTO RICO, 1935-36

Item	Number of cows			
	Lower third	Middle third	Upper third	Average
	Average per farm			
Number of farms	20	20	20	60
Number of cows	30	62	151	81
MEASURE OF FARM EARNINGS:				
Labor income	$2,012	$1,003	$4,692	$2,569
SIZE OF BUSINESS:				
Capital invested	$22,304	$49,510	$102,113	$57,976
Man equivalent	8	12	21	14
Total milk production (100 qts.)	452	875	2,637	1,321
Milk sales (100 qts.)	417	804	2,539	1,253
Gross receipts	$9,198	$12,796	$32,156	$18,050
DIVERSITY OF BUSINESS:				
Receipts from sugar cane	$3,357	$3,875	$3,276	$3,503
Value of milk sales	$4,180	$6,922	$24,771	$11,958
Per cent receipts from sugar cane were of total	36	30	10	19
RATES OF PRODUCTION:				
Milk production per cow (qts.)	1,509	1,399	1,748	1,629
Milk sold per cow (qts.)	1,392	1,287	1,683	1,546
Value of milk sold per cow	$140	$111	$164	$147
LABOR EFFICIENCY:				
100 quarts of milk per man	54	73	124	85
OTHER FACTORS:				
Capital turnover	2.4	3.9	3.2	3.2
Average price of milk (cents per qt.)	10.0	8.6	9.8	9.5

In contrast with this group, the largest farms as measured by number of cows averaged 151 cows, handled 12,400 quarts of milk per man, and sold 1,683 quarts of milk per cow at an average price of 9.8 cents per quart with a total value of milk of $160 per cow. They averaged $4,692 labor income. Since milk sold at about the same price per quart, this difference in labor income may be explained by the fact that this group had a better rate of production per cow, a much higher number of cows, and a better labor efficiency than small herds. The lower labor income in the middle group can be explained by the fact that the production per cow was the smallest in this group and the price of milk per quart the lowest, and consequently the value of milk sold per cow.

The receipts from sugar cane were about equal in the three groups which showed that this factor remaining about constant for the three groups, the efficiency of the labor as measured by the quarts of milk handled per man increased as the number of cows increased. Receipts from sugar cane include those obtained by the landlord and tenant for both cash sales and benefit payments from the Agricultural Adjustment Administration.

Relation of Rate of Production to Farm Earnings

Milk production per cow: The relation between milk production per cow and labor income is close. It is important to get a high milk production per cow to get a high output of milk per man and thus lead to a good labor income. This is especially true when labor is high priced.

The lower-third group had an average milk production per cow of 1,028 quarts and an average labor income of $1,661. In this group the average quarts of milk handled per man was 5,100 quarts and the value of milk sales per cow amounted to $81 at an average price of 8.4 cents per quart (table 24).

TABLE 24. RELATION OF MILK PRODUCTION PER COW TO FARM EARNINGS AND OTHER FACTORS

60 DAIRY FARMS, PUERTO RICO, 1935-36

Item	Milk production per cow			
	Lower third	Middle third	Upper third	Average
	Average per farm			
Number of farms.	20	20	20	60
Milk production per cow (quarts)	1,028	1,448	2,177	1,629
MEASURE OF FARM EARNINGS:				
Labor income	$1,661	$2,253	$3,792	$2,569
SIZE OF BUSINESS:				
Number of cows	68	75	100	81
Total milk production (100 quarts)	703	1,087	2,174	1,321
Gross receipts	$13,524	$14,825	$25,800	$18,050
DIVERSITY OF BUSINESS:				
Value of milk sales	$5,506	$10,382	$19,985	$11,958
Receipts from sugar cane	$6,288	$2,176	$2,044	$3,503
Per cent receipts from sugar cane were of total.	46	15	8	19
LABOR EFFICIENCY:				
100 quarts of milk per man.	51	102	126	95
OTHER FACTORS:				
Feeds purchased	$1,117	$2,436	$4,823	$2,792
Value of milk sold per cow.	$81	$138	$200	$147
Feed purchased per cow.	$16	$32	$48	$34
Average price of milk (cents).	8.4	10.0	9.7	9.5

The middle-third group had an average production per cow of 1,448 quarts of milk and a labor income of $2,253. On these farms the amount of milk handled per man averaged 10,200 quarts, and the value of milk sales per cow was $138 at an average price of 10 cents per quart.

In the group with the highest milk production per cow, they averaged 2,177 quarts and a labor income of $3,792 per farm. Milk handled per man averaged 12,600 quarts and the value of the milk

sold per cow averaged $200, sold at an average price of 9.7 cents per quart.

The difference in milk production per cow may be partly explained by the amount of feed purchased per cow. The farms having the lowest production fed the least amount of concentrates ($16 per cow) while the second group fed twice as much ($32 per cow) and the third group having the highest milk production per cow fed three times the amount fed by the lowest group or $48 per cow. The upper-third group was more specialized in the production of milk as may be shown by the percentage which the recepits from sugar cane were of the total receipts. In this group this percentage amounted to 8 per cent while in the lower-third group it was 46 per cent. It is assumed that the low-production group devoted about half of its time in the care and management of the dairy herd and about half of the time in the production of sugar cane, while the group having the highest milk production per cow devoted about all of its time in the care and management of its dairy herd.

The Relation of Labor Efficiency to Farm Earnings

Hundred quarts of milk per man: On strictly dairy farms, the number of quarts of milk produced per man is a very good measure of efficiency; but when you have such a combination as dairy and sugar cane farming the results are distorted due to the fact that sugar cane growing, being an intensive crop, needs a great deal of labor and thus increases materially the man equivalent of a farm, with the resulting decrease in efficiency when measured by the amount of milk handled per man. In the group of farms in which there were 30 farmers reporting sales of sugar-cane this was the case.

In the lower-third group, as to milk produced per man, the amount of milk handled per man was about 4,000 quarts with an average labor income of $2,001 per farm. Besides, they cared for 6.0 net *cuerdas* in crops and 5.6 animal units per man. This group had an average of 58 cows per farm and 110 net *cuerdas* in crops and $8,270 receipts from sugar cane. They were specialized in the production of both sugar cane and milk (table 25.)

TABLE 25. RELATION OF 100 QUARTS OF MILK PER MAN TO FARM EARNINGS AND OTHER FACTORS

60 DAIRY FARMS, PUERTO RICO, 1935–36

Item	100 quarts of milk per man			
	Lower third	Middle third	Upper third	Average
	Average per farm			
Number of farms	20	20	20	60
100 quarts of milk per man	40	96	166	95
MEASURE OF FARM EARNINGS:				
Labor income	$2,001	$1,366	$4,340	$2,569
SIZE OF BUSINESS:				
Number of cows	58	57	129	81
Man equivalent	18	9	14	14
Total milk production (100 quarts)	732	860	2,372	1,321
Gross receipts	$16,960	$11,167	$26,022	$18,050
DIVERSITY OF BUSINESS:				
Receipts from sugar cane	$8,270	$1,430	$808	$3,503
Value of milk sales	$6,195	$7,897	$21,781	$11,933
LABOR EFFICIENCY:				
Net *cuerdas* in crops per man	6.0	4.4	3.2	4.7
Animal units per man	5.6	9.6	12.2	8.7
OTHER FACTORS:				
Labor expenses	$4,727	$2,106	$4,366	$3,733
Feed purchased	$1,512	$1,994	$5,070	$2,702
Farm expenses	$10,259	$6,954	$15,315	$10,843

In the middle-third group the amount of milk handled per man was about 9,600 quarts and an average labor income of $1,366. Although they handled 9.6 animal units per man they also cared for 4.4 net *cuerdas* in crops. Cows per farm averaged 57 and the net *cuerdas* in crops per farm averaged 39 while the receipts from sugar cane amounted to $1,430.

The upper-third group averaged about 16,600 quarts of milk per man and a labor income of $4,340 per farm. In this group, each man handled 12.2 animal units and 3.2 net *cuerdas* in crops. The average number of cows for these farms was 129 and the net *cuerdas* in crops was 46. The receipts from sugar cane amounted to only $808 per farm.

The efficiency as measured by net *cuerdas* in crops handled per man decreased as the efficiency measured by 100 quarts of milk per man increased. The lower-third group had much more land in sugar cane in which they were highly specialized while the upper-third group was highly specialized in milk production. This can be shown too by the animal units per man which increased as the 100 quarts of milk per man increased.

The higher labor income in the third group has been due to the large size of business as measured by the number of cows (129), the

high milk production per cow (1,837 quarts), and consequently high value of milk sold per cow ($169), and increased efficiency (16,600 quarts per man). The combination of these factors brought about a higher labor income for this group.

Relation of the Diversity of the Farm Business to Farm Earnings

Percentage of income from crops sold: The proportion of total receipts furnished by crops was nothing for the lower third group, 14 per cent in the second group and 58 per cent in the last group when the farms were sorted by the percentage of the income from crops sold (table 26).

TABLA 26. RELATION OF PERCENTAGE OF RECEIPTS FROM CROPS TO FARM EARNINGS AND OTHER FACTORS

60 DAIRY FARMS, PUERTO RICO, 1935–36

Item	Percentage of receipts from crops			
	Lower third	Middle third	Upper third	Average
	Average per farm			
Number of farms	20	20	20	60
Percentage of receipts from crops	0	14	58	21
MEASURE OF FARM EARNINGS:				
Labor income	$3,404	$1,665	$2,639	$2,569
SIZE OF BUSINESS:				
Net *cuerdas* in crops	37	58	100	65
Number of cows	106	82	56	81
Total milk production (100 quarts)	1,928	1,301	735	1,321
Gross receipts	$21,914	$16,177	$16,059	$18,050
DIVERSITY OF BUSINESS:				
Crop sales	$3	$2,212	$9,291	$3,835
Receipts from sugar cane	0	$1,570	$8,938	$3,503
Value of milk sales	$18,918	$11,762	$5,193	$11,958
LABOR EFFICIENCY:				
100 quarts of milk per man	158	105	43	95
Net *cuerdas* in crops per man	3.0	4.7	5.9	4.7
RATES OF PRODUCTION:				
Milk production per cow (quarts)	1,827	1,594	1,309	1,629
Milk sales per cow	$179	$144	$92	$147

When sorted on the basis of "the percentage of receipts from crops" the farms which received no income from the sale of crops had the best net returns. This would tend to show the advisability of a high degree of specialization in dairy production. When the farms were sorted on the basis of size, however, as in table 22, the larger, somewhat more diversified farms had the best returns. From these data it would seem as though some diversity is desirable on dairy farms in this region. This is particularly true on the larger farms and on farms where the soil and markets provide favorable

conditions for crop production. In addition, this diversity might help to avoid what might be called "local over-production", which might too seriously affect the local prices of dairy products.

Although this table indicates that milk sales per cow decreased as the percentage of income from crops increased, table 22 indicates that some farms at least had a high income per cow along with a diversified farm program.

Relation of Age of the Farm Operator to Farm Earnings

The average age of the operator on these farms was 44 years. The youngest operators who averaged 32 years of age had the second highest labor income or $2,823 per farm (table 27). The older men having an average of 57 years of age had the lowest labor incomes, or $1,609 per farm. The middle-aged farmers, who averaged 44 years, made the highest labor incomes ($3,178), turned over their capital faster, handled more cows, and so produced more milk and used more capital than the other two groups composed of younger and older farmers, respectively.

TABLE 27. RELATION OF AGE OF THE FARM OPERATOR TO FARM EARNINGS AND OTHER FACTORS

60 DAIRY FARMS, PUERTO RICO, 1935–36

Item	Age			
	Lower third	Middle third	Upper third	Average
	Average per farm			
Number of farms	19	22	19	60
Age	32	44	57	44
MEASURE OF FARM EARNINGS:				
Labor income	$2,823	$3,178	$1,609	$2,569
SIZE OF BUSINESS				
Capital invested	$55,424	$68,797	$47,998	$57,976
Number of cows	76	104	60	81
Gross receipts	$17,006	$22,896	$13,483	$18,050
DIVERSITY OF BUSINESS				
Receipts from sugar cane	$3,453	$2,531	$4,673	$3,503
Value of milk sales	$11,294	$16,717	$7,112	$11,958
OTHER FACTORS:				
Capital turnover	3.3	3.0	3.6	3.2

It appears that the labor incomes of younger farmers are higher than those of older farmers. For one thing, older farmers had the smallest-sized business which may account for their lower labor incomes, although they had more sugar cane as measured by the receipts from sugar cane, which ought to compensate somewhat for the smaller size of business. One probable explanation why the youngest

farmers had a smaller size of herd is that they are building up their herds, and who knows if in 10 or 12 years they would have the same number of cows as the middle-third group. Another probable explanation why the older farmers have less cows is that a great deal of attention and care is needed for the dairy herd and usually working at very inconvenient hours. For this reason they may tend to reduce their herds. At the same time they may increase their sugar cane which is more convenient to work, although at the present Puerto Rico has a quota for sugar cane production and thus limits the number of acres or tons of sugar cane to be produced by individual farmers.

Relation of Farm Tenure to Farm Earnings

Twenty-nine farmers were full owners and 21 were tenants or part owners. There was not much difference in labor incomes between full owners and part owners. Although the full owners had less capital invested they handled less cows, but the differences are not significant. Both groups had the same percentage return on capital which was 10 per cent (table 28).

TABLE 28. RELATION OF TENURE TO FARM EARNINGS AND OTHER FACTORS

60 DAIRY FARMS, PUERTO RICO, 1935-36

Item	Tenure		
	Full owners	Tenants and part owners	Average
	Average per farm		
Number of farms	29	31	60
MEASURE OF FARM EARNINGS:			
Labor income	2,631	2,511	$2,569
Labor earnings	3,086	3,013	3,048
Return on capital	5,719	5,941	5,834
Per cent return on capital	10	10	10
SIZE OF BUSINESS:			
Number of cows	77	85	81
Capital invested	$54,811	$60,936	$57.976

Method of Milk Marketing and Farm Earnings

Method of milk marketing: There were 14 retailers, 30 wholesalers, and 16 wholesalers-retailers of the farms studied (table 29), The average labor income for these groups were $2,565 for the retailer, $2,236 for the wholesaler, and $3,196 for the wholesaler-retailer. It might have been expected that the retailer would have had a better income; this was not the case. Although the average price

of milk on the "retail farms" was higher, these farms had fewer cows, a smaller volume of business and thus lower net returns than on wholesaler-retailed farms. In favor of the wholesaler-retailers is the fact that they had a larger business, better milk production per cow, and better efficiency which accounted, no doubt, for the better labor income.

The wholesaler, although selling a little more milk per cow than the retailers, the difference in price of 4.6 cents per quart resulted in a much lower value of milk sold per cow ($65 lower). The retailers and wholesalers had about the same number of cows but the total receipts from milk sales averaged about $5,000 less for the wholesaler. There was only about $1,000 difference in gross receipts and $329 in labor income, however, since the wholesalers received a greater proportion of the farm income from sugar cane.

TABLE 29. RELATION OF METHOD OF MILK MARKETING TO FARM EARNINGS AND OTHER FACTORS

60 DAIRY FARMS, PUERTO RICO, 1935-36

Item	Method of milk marketing			
	Retail	Wholesale	Both	Average
	Average per farm			
Number of farms	14	30	16	60
MEASURE OF FARM EARNINGS:				
Labor income	$2,565	$2,236	$3,196	$2,569
SIZE OF BUSINESS:				
Number of cows	75	74	101	81
Man equivalent	12	14	16	14
Gross receipts	$17,023	$15,900	$22,980	$18,050
DIVERSITY OF BUSINESS:				
Value of milk sales	$13,610	$8,629	$16,754	$11,958
RATES OF PRODUCTION:				
Milk sold per cow (quarts)	1,447	1,474	1,707	1,546
Value of milk sold per cow	$182	$117	$166	$147
OTHER FACTORS:				
Milk sold retail (100 quarts)	1,081	....	937	502
Milk sold retail, value	$13,610	....	$10,640	$6,013
Milk sold wholesale (100 quarts)	....	1,084	784	751
Milk sold wholesale, value	....	$8,629	$6,114	$5,945
Milk sold retail (price per quart)	12.6¢	....	11.4¢	12.0¢
Milk sold wholesale (price per quart)	....	8.0¢	7.8¢	7.9¢
Average price per quart	12.6¢	8.0¢	9.7¢	9.5¢
Per cent milk—retailed	100	....	54	40
wholesaled	....	100	46	60

Value of milk sold per cow: The value of the milk sold per cow averaged $74 in the lower-third group, $121 in the second group, and $200 in the third group. Their average labor incomes were $1,710, $1,497, and $4,499, respectively (table 30).

TABLE 30. RELATION OF VALUE OF MILK SOLD PER COW TO FARM EARNINGS AND OTHER FACTORS

60 DAIRY FARMS, PUERTO RICO, 1935-36

Item	Value of milk sold per cow			
	Lower third	Middle third	Upper third	Average
	Average per farm			
Number of farms	20	20	20	60
Value of milk sold per cow	$74	$121	$200	$147
MEASURE OF FARM EARNINGS:				
Labor income	$1,710	$1,497	$4,499	$2,569
SIZE OF BUSINESS:				
Number of cows	60	67	116	81
Gross receipts	$12,438	$12,324	$29,388	$18,050
DIVERSITY OF BUSINESS:				
Value of milk sales	$4,411	$8,106	$23,356	$11,958
Receipts from sugar cane	$6,300	$2,525	$1,682	$3,503
RATES OF PRODUCTION:				
Milk sold per cow (quarts)	970	1,447	1,898	1,546
OTHER FACTORS:				
Labor expenses	$3,279	$2,642	$5,279	$3,733
Feed purchased	$978	$2,018	$5,380	$2,792
Feed purchased per cow	$16	$30	$46	$35
Average price of milk (cents)	7.6	8.4	10.6	9.4

The figures in this table indicate that a fairly high degree of specialization on these dairy farms is associated with the higher farm earnings. Although the middle-third group had a better milk production per cow, a better price, a few more cows, and a much higher value of total milk sales, their labor income was smaller than the lower-third group. For one thing, the total labor and feed expenses for the middle-group were larger than for the lower-third, while the receipts from sugar cane were much lower. Consequently, having less total receipts and more expenses, it is only natural that their labor incomes should be lower than the lower-third group. The increased production per cow was accompained by an increase in expenses for feed purchased.

The advantages of the upper-third group are such that their labor income is much higher than the first two groups. These advantages are a higher milk production per cow, a better price of milk, larger size of herd, and a better efficiency which combinations resulted in high labor incomes.

EFFECT OF A COMBINATION OF FACTORS ON FARM EARNINGS

Relation of different factors above and below average to labor income: Farms were sorted on different factors above and below the average for all farms and the results are shown in table 31.

TABLE 31. RELATION OF DIFFERENT FACTORS ABOVE AND BELOW AVERAGE TO LABOR INCOME

60 DAIRY FARMS, PUERTO RICO, 1935–36

Factor	Below average	Average	Above average	Below average	Average	Above average
					Labor Income	
Total cuerdas in farm	127	218	473	$1,475	$2,569	$4,601
Number of cows	45	81	148	1,498	2,569	4,558
Milk sales per cow	$97	$147	$199	1,540	2,569	4,479
Milk production per cow (quarts).	1,203	1,629	2,122	1,871	2,569	3,691
100 quarts of milk per man	48	95	152	1,558	2,569	3,515
Per cent income from crop sales ...	5	21	54	2,565	2,569	2,575

Those farms which were above the average in total *cuerdas* in farm had an average of 473 *cuerdas* and a labor income of $4,601, while those below had 127 *cuerdas* and a labor income of $1,475.

Farms below average in number of cows had 45 cows and a labor income of $1,498, while those above average had 148 cows and a labor income of $4,558.

The value of milk sales per cow for those farms below average was $97 and their labor income $1,540 per farm. Those above average in value of milk sales per cow had a value of milk sales of $199 per cow and $4,479 labor income per farm.

The value of milk sales per cow for those farms below average was $97 and their labor income $1,540 per farm. Those above average in value of milk sales per cow had a value of milk sales of $199 per cow and $4,479 labor income per farm.

Farms below average in milk production per cow averaged 1,203 quarts per cow and a labor income of $1,871 per farm, while those above average produced 2,122 quarts per cow and a labor income of $3,691 per farm.

The 100 quarts of milk handled per man on farms below average for this factor was 4,800 quarts per man and labor income of $1,558

per farm, while those above average handled 15,200 quarts per man and a labor income of $3,515 per farm.

There was no significant difference for farms below and above average in percentage of income from crop sales.

The results shown in this table point out the necessity of being above average in at least one of these factors if they are to obtain high financial returns from their businesses. Large businesses accompanied by good rates of production and efficiency are likely to make the best labor incomes.

Effect of combination of factors on labor income: All farms above average in any one of the following factors: total *cuerdas* in farm, number of cows, man equivalent, value of milk sales per cow, milk production per cow, 100 quarts of milk handled per man and percent income from crop sales, had on the average labor incomes from about one and a-half times as great to about twice as great as the average of all farms (table 32). The highest labor income was obtained by those farms above average in total *cuerdas* in farm, amounting to $4,601 per farm; the lowest labor income by those above average in percentage of income from crop sales, amounting to $2,575 per farm.

Groups of farms above average in two factors had labor incomes about two and a-half times as large as the average for all farms.

The groups of farms above average in three factors had labor incomes about two and one-half to three times as large as the average labor income for all farms.

The groups of farms above average in four factors had their labor incomes about three times as large as the average for all farms. The

TABLE 32. EFFECT ON LABOR INCOME OF HAVING DIFFERENT FACTORS ABOVE AVERAGE

60 DAIRY FARMS, PUERTO RICO, 1935-36

Item	Number of farms	Average in item	Average for all farms	Labor income
				Dollars
Average for all farms	60			2,569
ABOVE AVERAGE IN ONE FACTOR:				
Total *cuerdas* in farm	21	473	248	4,601
Number of cows	21	148	81	4,558
Man equivalent	21	26	14	4,416
Value of milk sales per cow	21	199	147	4,479
Milk production per cow (quarts)	23	2,122	1,629	3,691
100 quarts of milk per man	31	152	95	3,515
Per cent income from crop sales	22	54	21	2,575
ABOVE AVERAGE IN TWO FACTORS:				
Number of cows and milk production per cow	11			6,749
Number of cows and milk sales per cow	12			6,526
Number of cows and 100 quarts of milk per man	14			6,027
Number of cows and total *cuerdas* in farm	15			4,895
Milk sales per cow and 100 quarts of milk per man	15			5,750
ABOVE AVERAGE IN THREE FACTORS:				
Number of cows, milk production per cow and milk sales per cow	9			6,416
Number of cows, milk production per cow and 100 quarts of milk per man	10			6,504
Number of cows, milk sales per cow and 100 quarts of milk per man	10			7,461
ABOVE AVERAGE IN FOUR FACTORS:				
Number of cows, milk production per cow, milk sales per cow, and 100 quarts of milk per man	8			7,1[illegible]8
Number of cows, milk production per cow, 100 quarts of milk per man, and man equivalent	6			8,214
Number of cows, milk sales per cow, 100 quarts of milk per man, and man equivalent	7			8,550
ABOVE AVERAGE IN FIVE FACTORS:				
Number of cows, milk production per cow, milk sales per cow, 100 quarts of milk per man, and man equivalent	6			8,214

best combination of factors was supplied by number of cows, value of milk sales per cow, 100 quarts of milk handled per man and man equivalent, their labor income amounting to $8,550 per farm.

The highest labor income for any farm was $10,565. If this fact is kept in mind by the reader while analyzing table 32, the importance of these combinations of factors can be realized more readily.

One of the most important factors while in combination with others in this study, although not so significant alone, is the quarts of milk handled per man. It was not so significant alone because of the sugar cane grown in these farms. Those farms above average in this factor made a labor income of $3,515 per farm, but when combined with number of cows the labor income was increased to $6,027 per farm or to $5,750 per farm when combined with value of

milk sales per cow. Farms with number of cows and value of milk sales per cow above the average and that handled more quarts of milk per man than the average made labor incomes of $7,461.

SUMMARY

Since the introduction of dairy breeds of cattle in Puerto Rico in 1911, a great improvement has been seen in the dairy industry. Especially has there been an increase in milk production per cow. From 1920 to 1935, the average increase in milk production per cow was 27 per cent and the increase in the number of cows milked about 23 per cent. The average milk production per cow in 1935 was 1,657 pounds of milk.

The most important kinds of pasture grasses in the Island are Guinea grass and Para grass. Of minor importance are Guatemala, Elephant, and Molasses grass. In 1929, there were 21,980 acres of the first two mentioned, and 6,713 acres of the last mentioned in addition to other grasses. Neither hay nor silage is fed to cows.

Of the total number of cattle in Puerto Rico in 1930, there were 4,144 purebred registered animals on farms which represent about 1.4 per cent of the total.

In 1935, there were 23,335 farms reporting cows milked or about 44 per cent of the total number of farms. According to the Census of Agriculture of 1935, there were 661 dairy farms in Puerto Rico, that is, farm on which milk was the principal source of income.

The average size of the farms studied was 248 *cuerdas,* with 65 net *cuerdas* in crops and 166 *cuerdas* in permanent pasture. The average farm capital was $57,976. Of the 60 farms studied 29 farmers were full owners, 10 rented the land, and 21 were part owners of the land. The usual relationship existing between the landlord and tenant was the paying cash of the latter to the former for the rent of the land.

Sugar cane was the most important source of income of all the crops planted. Yields of the different crops in some instances were high, in other low, and about the average in others.

The average number of cows per farm included in this study was 81 with an average milk production of 1,629 quarts. The majority of the cows as well as the bulls had some Holstein-Friesian blood. Milk sales per farm amounted to 125,341 quarts sold with a total value of $11,958 per farm at an average price of 9.5 cents per quart. This value represented 70 per cent of the total receipts. (See table

21.) There were 14 retailers, 30 wholesalers, and 16 wholesaler-retailers

The average expenses including unpaid labor, landlord's and operator's expenses but excluding rent, were $9,859 per farm.

The average labor income on these farms was $2,569 during 1935–36. Only 16 farmers or about 27 per cent of the total made negative labor incomes. The range in labor income was from $2,551 to $10,565.

The relation of total *cuerdas* in farm to labor income showed a consistent increase in labor income as the size of the farms increased. All other size factors increased as size of farm increased. (See table 22.)

When the farms were sorted into three groups on the basis of number of cows, the farms with the least number of cows had better labor incomes than did those in the middle group but less than the farms in the group with the largest number of cows. The lower production per cow and the lower price received for milk quite largely accounted for the lower average labor income of the formers in the middle-third group. The labor incomes on farms having the most cows averaged about 83 per cent higher than the average. (See table 23.)

Farms having the lowest-milk production per cow had the lowest labor income, while those having the best production per cow had the best labor incomes. Both the number of cows and value of milk sales per cow increased with increased production per cow. (See table 23.)

The amount of milk handled per man did not show as consistent relationship to labor income because of the fact that the farms with the lowest efficiency had much higher receipts from sugar cane than the other two groups. In the middle and in the upper-third groups where milk production was of most importance, the labor income of the farms with highest efficiency was about three times as high as the farms of the middle group. Not taking into consideration the sugar cane, the amount of milk handled per man shows a close relationship to labor income. (See table 25.)

When the farms were sorted on the basis of percentage of receipts from crops, those farms whose percentage receipts from crops were the lowest (0 per cent) had the highest labor incomes, but those having the highest percentage receipts from crops had the second highest labor income. (See table 26.)

The oldest farmers had the poorest labor incomes and the youngest the second best labor incomes. The middle-aged farmers had the best labor incomes due to the larger size of business. (See table 27.)

Difference in farm tenure did not affect significantly the labor income. (See table 28.)

Those farmers who sold their milk at wholesale had the poorest labor incomes and those who sold at both retail and wholesale had the best labor incomes due no doubt to a better production per cow, large business and better efficiency. (See table 29.)

Farms whose value of milk sold per cow was the highest had the best production per cow, best price for their milk, larger businesses and consequently higher-labor incomes. Those having the lowest value of milk sold per cow had the second highest-labor incomes. Their production per cow and price of milk was the lowest but their receipts from sugar cane were much higher than for the other two groups, which may account for their labor incomes being the second highest. (See table 30.)

When sorts were made on the basis of being above average in one or more important factors, the labor incomes were always highest in the group of farms above average in a particular factor such as total *cuerdas* per farm, milk production per cow, etc. The highest incomes, however, were obtained on farms which were above average in more than one factor such as a combination of the number of cows, value of milk sales per cow, hundred quarts of milk handled per man and man equivalent. Those farms being above average in these four factors made a labor income of $8,550 per farm or about 233 per cent above the average. (See tables 31 and 32.)

RECOMMENDATIONS

On the basis of this study, there is a possibility for some dairy farmers to improve the organization of their businesses and to obtain higher returns. The following are some of the points in which some farms may be improved: (1) a large size of business, (2) a high-milk production per cow, (3) a high-labor efficiency, (4) a good price for milk, and (5) a uniform milk production during the year for those selling at retail and a higher production during the months of November to March inclusive for those selling wholesale to obtain the benefits of higher prices during that period.

There were many farmers who were below the average in at least one of these factors. They should study their farm businesses and see what is the weakest point or points and try to improve it to get

the highest returns possible. A combination of all of these factors in any farm will undoubtedly result in the greatest profits for the farmer.

Other recommendations which are worthwhile for dairy farmers to consider are:

1. To start a pasture improvement system in their farms (sixty-seven per cent of the land in these farms was in permanent pasture and 10 per cent in soilage crops). It is a well known fact that the greatest percentage of the land in permanent pasture is in pastures which are not cultivated or fertilized, being in its majority "grama", a non-cultivated grass. As a result of a pasture improvement system there would be no scarcity of it during the dry season and no doubt the feed bill would be reduced greatly.

2. To replace all grade bulls with purebred registered bulls of a good pedigree (seventy-eight per cent of the bulls on these farms were grades). If further improvement in the production of milk per cow is sought, it is a necessity for the farmer to keep only purebred registered bulls of a good pedigree. In general, the farmers overlook the fact that the bull constitutes at least 50 per cent of a dairy.

3. To improve the feeding methods of both cows and calves. Sometimes, a good and a poor cow are fed the same amount of concentrates, which of course is a mistake. A cow should be fed according to its production of milk as well as its weight. In general, it is wise to state that a cow should be fed one pound of concentrates for every 3 pounds of milk produced. For the farmers who are raising their calves for replacements they should be fed the right amount of feeds. A calf which is stunted during its early development will never recover from it. It will develop into a poorer cow than would have been the case if proper feeding had been followed.

4. To keep production as well as other records in their farms. The farmer should keep a production record in order to be able to select the best cows as well as their progeny and discard the poorest cows. This record will serve him for the purpose of feeding the right amount of concentrates to each cow.

A breeding record is essential too. The farmer will know when is the calf expected so that the cow be dried at the right time. He should avoid by all means the freshening of a cow while producing milk. It is necessary for him to keep the bull in a pen if he wants to accomplish this and avoid money losses.

5. To keep only good cows. The farmer should discard the poorest cows of his herd and keep only the best cows. It is a well known fact that a good cow may be more profitable than two poor cows. The cost of keeping a herd of 50 good cows producing the same total amount of milk than a herd of 100 poor cows is much less with a much higher profit in the enterprise.

6. To follow a disease control program in their farms. In general, the farmers lack the necessary knowledge about diseases and their control. In some cases they call the veterinarian when it is too late and a valuable cow may be lost. Make use of him at the right time. Separate a diseased cow from the rest of the herd, and if it may become a disease carrier by all means dispose of it—the sooner the better.

There is no doubt that if these recommendations are followed by any farmer it will result in a decrease in costs and a consequent increase in profits. If any farmer is profited by our suggestions our goal has been attained.

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INSECTS OBSERVED IN THE STATE OF ARAGUA, VENEZUELA, SOUTH AMERICA *

By LUIS F. MARTORELL.

INTRODUCTION

Venezuela is still an almost virgin field for naturalists, with vast regions quite unexplored by botanists or zoologists. The older naturalists, such as Loefling, Von Jacquin, Humboldt, Bondplant, Pleé, Vargas, Moritz, Spruce and others, collected mostly flowering plants and the larger or more conspicuous animals, but even their botanical records are far from complete.

Some of the naturalists who visited Venezuela early in the last century not only collected flowering plants, but also fungi and insects. Short papers based on, or listing, these collections were published in various parts of Europe in a wide variety of publications, many of which are now obscure or forgotten, and the task of collecting them all is almost hopeless.

The writer had the oportunity of making entomological collections in the State of Aragua, Venezuela, for fourteen months. The last seven months were spent at La Providencia, in the Aragua Valley, where the school of agriculture (Escuela de Expertos Agro-Pecuarios) is situated. La Providencia is nine kilometers from Maracay, the Capital of the State, and three kilometers from Turmero, the largest near-by town.

While at La Providencia, a fairly large collection of insects was made by the writer, in collaboration with many of his pupils, not only there, but also in the near-by towns. Also, many specimens from outside of Aragua were obtained in Caracas (Capital of Venezuela), Los Teques, Río Chico, San José de Río Chico, Ocumare del Tuy and Cúa (Estado Miranda). The insects listed in this paper represent only a small portion of those which could be obtained by more intensive collection in this region.

* This annotated list, with minor changes, was presented in partial fulfillment of the requirements for the degree of Master in Science at Ohio State University.

As some of the insects were collected by Mr. Eliseo Serres Domínguez, the initials E. S. are used for his specimens. No collector's name appears on the specimens of the collections made by the writer. The initials M. & S. indicate a joint collection by Martorell and Serres.

Some of the insects here listed are new to Venezuela. Many of them, however, have been cited before by other workers, but collected in different localities.

Among the Diptera, new species were found and in the family *Scarabaeidae* (*Coleoptera*) there is probably a new genus and species. Some of the specimens were new to the United States National Museum Collection and were retained there. Specimens of a number of species have been deposited in the Insect Collection of the Ohio State University, Columbus, Ohio.

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The writer expresses his sincere gratitude to his pupils of the School of Agriculture in Maracay who aided in collecting, particularly to Mr. Eliseo Serres Domínguez, Mr. Raúl de Armas, Mr. Anselmo Escalona Salas, Mr. José L. Maury, Mr. Manuel Palma, Mr. Juan Ramón Jurado and Mr. Fernández. To Mr. Jaime Guiscafré Arrillaga, Mr. Hipólito Soltero, Mr. Juan Gunther Fortman, members of the Faculty and to Dr. Germán Buroz, Civil Engineer of the Ministry of Health and Agriculture, in Caracas, Venezuela, the writer is indebted for help. Mr. Claudio Urrutia took interest and made efforts in classifying the insects in the collection. Both he and Mr. José L. Colom, of the Pan-American Union were helpful in transmitting insect specimens to the U. S. National Museum.

Without the classification of the insects this work would not have been possible. The following specialists in the U. S. National Museum, at Washington, D. C., contributed greatly to the success of this work: Dr. E. A. Chapin, Mr. H. S. Barber, Mr. W. S. Fisher, and Mr. L. L. Buchanan, for the Coleoptera; Mr. H. G. Barber, Mr. P. W. Oman and Dr. H. Morrison, for the Heteroptera; Mr. A. N. Caudell, for the Orthoptera; Dr. J. M. Aldrich, Mr. C. T. Greene, and Mr. Alan Stone for the Diptera; Dr. W. Schaus for the Lepidoptera; Miss Grace A. Sandhouse, Mr. R. A. Cushman, Mr. C. F. W. Muesebeck, Dr. W. M. Mann and Mr. A. B. Gahan for the Hymenoptera. Dr. Herbert Osborn and Dr. D. J. Borror, of the Ohio State University determined the Homoptera and Odonata respectively. To the former and to Dr. Alvah Peterson, Dr. C. H. Kennedy and Dr. J. Knull the writer is indebted for their suggestions, criticisms and advice.

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THYSANURA

Lepisma sp. (Det. L. F. Martorell)
Common in trunks, cases and boxes with books and old clothes. At La Providencia and Caracas.

DERMAPTERA

(All determinations by A. N. Caudell.)

Doru lineare Esch.
Abundant under dead stumps, leaves and branches, at Samán de Guere, La Providencia and Gonzalito. Col. Serres, Palma and Martorell.

Anisolabis maritima Gené
Found under the same situation as the above species, at La Providencia.

Prosparatta humilis Hebard.
Under logs and stones near Samán de Guere and Turmero.

ORTHOPTERA

(All determinations by A. N. Caudell.)

Blattidae

Blaberus discoidalis Serv.
Very common in houses. The specimens collected were found under stored seed bags, at La Providencia. Col. M. & S.

Blaberus trapezoideus Burm.
Specimens collected abundantly at lights near Samán de Guere. Col. Martorell, Serres and Palma.

Dendroblatta sobrina Rehn
These small roaches are very common below logs, dry leaves and other debris on the soil, in humid places. Near La Providencia and Samán de Guere.

Leucophaea maderae Fabr.
A common pest in the region. The writer has observed this same species not only at Turmero, La Providencia and Maracay, but also in Caracas. Specimens collected at La Providencia.

Panchlora nivea Linn.
Common usually in plantain and banana groves, near La Providencia and Turmero.

Periplaneta australasiae Fabr.
A common species in Aragua, in kitchens, dining rooms, toilets, cellars, etc. At La Providencia and Gonzalito extremely abundant. The writer had found them also at Turmero, Maracay, Caracas, Los Teques and Ocumare del Tuy. Col. M. & S.

Periplaneta americana Linn.
As common as the preceeding species. Collected at La Providencia, Gonzalito and Turmero.

Pycnoscelus surinamensis Linn.
Common under logs, stones, in tree cracks, etc., in the forest near La Providencia.

PHASMIDAE

Calynda sp.
A female of this genus was collected by the writer on the dry branch of a forest bush, near La Providencia. The specimen measured 6 inches from the tip of the head to the posterior end. Does not seem to be a common insect in this region.

MANTIDAE

Acontista cayennensis Sauss. & Zehnt.
The specimen was collected while resting on a plant of *Salvia splendens* Sell., at La Providencia.

Musonia surinama Sauss.
Abundant species at La Providencia. Also found at Caracas, Turmero and Los Teques.

Phyllovates chlorophaea Blanch.
Collected during flight in the fields near La Providencia.

Stagomantis carolina var. **irrorata** Linn.
This species is not very abundant in the region. Only two or three specimens were seen during the time the writer stayed in Aragua. At La Providencia; also observed at Caracas and Los Teques (1,000 to 1,300 meters in altitude).

Gryllidae

Anurogryllus muticus var. **fuscus** Caudell

Abundant in fields and pastures near La Providencia and Samán de Guere. Sometimes they come inside houses and annoy with shrill chirping. Collected at La Providencia by M. & S.

Hemigryllus ortoni Scudder

Collected at night at La Providencia. Fairly common.

Miogryllus convolutus Joh.

In great numbers in pastures, under dry leaves, stones, or cracks in the soil. Extremely common species at Turmero, Maracay, La Providencia and Samán de Guere.

Nemobius longipennis Sauss.

A common species in the fields around La Providencia and Turmero.

Phylloscirtus elegans Guerin.

Only one specimen collected at light at La Providencia.

Scapteriscus didactylus Latr.

A common name in the Aragua region for this insect is "perro de agua" (water dog). A pest in vegetable gardens at La Providencia, Maracay, Turmero and Caracas. The cabbage plants were badly injured by this insect, but the use of insecticides kept them under control. The plants mostly attacked at the garden of the School of Agriculture, were: tomatoes, cabbages, lettuce, peppers, cucumbers and an ornamental plant of the genus *Kochia.* Near Turmero, tobacco was also attacked.

Tridactylus apicalis Say

Common in pastures, orchards, vegetable gardens, along the banks of streams, etc., at La Providencia, Turmero, Maracay, and Samán de Guere.

Tettigonidae

Conocephalus saltator var. **meridionalis** Scud.

In the pastures near La Providencia. Col. M. & S.

Homocoryphus sp.

Abundant in the pastures at La Providencia.

Meroncidius innotatus Walk.

An extremely abundant species during the rainy season. In fields, vegetable gardens and sometimes attracted to lights during the night. At La Providencia and near Samán de Guere.

Microcentrum sp.

At La Providencia.

Neconocephalus sp. (Det. L. F. Martorell)

Found in great numbers in the pastures and corn plantations near La Providencia and Turmero.

Peucestes dentatus Stal

This gigantic katydid is extremely common in the valley, also making its appearance during the rainy season. It is not so common as *Tropidacris dux* Drury (Locustidae), but is second in rank. La Providencia and Samán de Guere.

Philophyllia latior Brunn.

Common in the fields near La Providencia.

Stilpnochlora marginella Serv.

At La Providencia by M. & S.

Acrididae

Agriacris tricristata Serv.

Only one specimen was collected in the region of Aragua. The writer noted several specimens in the collection of the Ministry of Health and Agriculture in Caracas. (These collections were made by an old naturalist, by name Grisol). The specimens were labelled, "locality, Antimano".

Chromacris psittacus Gerst.

This insect is common near La Providencia often appearing in the fields in great numbers. The writer observed a swarm of several hundred moving in a field, among the weeds as if they were a single unit. Specimens were collected near Samán de Guere by Martorell & Maury.

Micronotus caudatus Sauss.

A very abundant species in the pastures near La Providencia, Maracay, Turmero and La Trinidad. Specimens collected at La Providencia and Samán de Guere. Col. M. & S.

Orphulella punctata De Geer
Abundant in pastures at La Providencia, Maracay and Turmero. Col. M. & S.

Osmilia flavolineata De Geer
Common species at La Providencia.

Paradichroplus sp.?
Fairly abundant in pastures near La Providencia.

Paulinia acuminata De Geer
Collected at Turmero and La Providencia, on weeds.

Tropidacris dux Drury
The most abundant locust during the rainy season in the region. Sometimes we had the opportunity to collect as many as thirty or forty in a few hours, attached to the wire screens in the tennis courts of the School of Agriculture at La Providencia. This species is also found at Maracay, Turmero, Cagua, Tejerías (Estado Aragua) and in Valencia (Estado Carabobo). When they migrate in great swarms, the damage done to the cultivated fields and other vegetation is considerable, but fortunately large migrations are not frequent in the region. The species is said to be very common in the Orinoco River region, where it is a real pest, sometimes flying across to the Island of Trinidad. The specimens in the collection are four to five inches in length and with a wing expanse of eight to nine inches The insect is one of the most beautiful species of tropical locusts.

ISOPTERA

Kalotermitidae

Cryptotermes brevis Walk. (Det. L. F. Martorell)
Very abundant in furniture and wooden buildings. It is a very destructive pest found in many regions of Venezuela, (Caracas, Ocumare del Tuy, Río Chico, San José de Río Chico, Los Teques and Cúa). Also common at La Providencia, Turmero, Maracay and Cagua.

Termitidae

Nasutitermes sp. probably **costalis** Holmgren
A representative species of this genus is one of the most destructive pests of cacao in many sections of Venezuela. At San

José de Río Chico nearly all the cacao plantations were infested. Not only attacking cacao, *Theobroma Cacao* L., but also *Mangifera indica* L., *Spondias dulcis* Frost and *Terminalia Catappa* L. Near La Providencia several trees of *Samanea Saman* (Willd.) Merril and *Bixa Orellana* L. were also found attacked by the same insect.

ODONATA

ZYGOPTERA

Damselflies were very common in the small streams and ponds in the region. Several specimens are in the collection, but they were not identified.

ANISOPTERA

AESCHINIDAE

Gynacantha mexicana Selys (Det. by D. J. Borror)
Common in the dark forest region of the locality, flying near streams.

LIBELLULIDAE

Erythemis attala Selys (Det. D. J. Borror)
Fairly common near La Providencia, flying along the banks of creeks.

Erythrodiplax connata fusca Rambur (Det. D. J. Borror)
The most common species of dragon-fly in the region. Very common near ponds, along the banks of rivers, small creeks and even in the fields. Col. M. & S.

ANOPLURA

PEDICULIDAE

Pediculus humanus humanus Linn. (Det. L. F. Martorell)
The common species of lice among unclean people. At La Providencia and Gonzalito.

Pediculus corporis De Geer (Det. L. F. Martorell)
Common in places where many people are crowded together, as in prisons and cheap boarding houses. At Maracay and Caracas.

Phthirius pubis Linn. (Det. L. F. Martorell)
Common in the public region of humans. Sometimes going to the underarms, head and even the eyebrows. At Caracas, Maracay, Turmero and probably the whole country.

HEMIPTERA

In the systematic arrangement of the group the writer follows Van Duzee in his "Catalogue of the Hemiptera of America, North of Mexico". (24)

HETEROPTERA

SCUTELLERIDAE

Pachycoris torridus Scopoli (Det. L. F. Martorell)
Collected at La Providencia. Not a very common insect in the region.

Symphylus spp. (Det. H. G. Barber)
Two different species of this genus are represented in the collection. This insect seems to be very abundant around La Providencia and Maracay. Col. & S.

Tetyra pinguis Germ. (Det. H. G. Barber)
Common at La Providencia and Samán de Guere.

CYDNIDAE

(Determinations in this group made by H. G. Barber.)

Aethus sp.
At light at La Providencia.

Cyrtomenus sp.
At light at La Providencia.

Scaptocoris terginus Schioedte
This insect becomes a real nuisance during the rainy nights at La Providencia. It is the favorite food of the toad, *Bufo marinus* L., during the season. About 90 % of the stomach contents of toads, during the time that these insects were abundant, consisted of *S. terginus*, according to dissections made by the writer. The toads do not seem to mind the repugnant odor of these bugs. During the first hours of the evening, when the bright lights inside the hall of the School of Agriculture were turned on, these insects would come in great numbers, attracted to the lights.

Pentatomidae

(Determinations in this family, as well as in the succeeding ones were made by H. G. Barber, unless otherwise stated.)

Alcaeorrhynchus grandis Dallas
At La Providencia.

Arocera apta Walk.
At La Providencia.

Arvelius albopunctatus De Geer
On weeds at La Providencia and near Maracay.

Chlorocoris depressus Fabr.
Fairly common in the vegetable garden at La Providencia. The specimens in the collection were taken from eggplant, *Solanum Melongena* L.

Edessa rufomarginata (var.) Dej.
This species is commonly found on tobacco near Turmero and La Providencia. Specimens were also obtained at El Cedral, near Caracas, at 1,500 meters in altitude, on a tobacco plant infested with these insects in all stages.

Edessa sp.
Collected at Cagua.

Euschistus triangulator H. S.
This species is fairly common at La Providencia and Samán de Guere.

Loxa flavicollis Drury
Species obtained at La Trinidad, Maracay, flying among weeds. Col. M. & S.

Mecistorhinus tripterus Fab.
A female of this species was found brooding its eggs on a grapefruit leaf, accompanied by a male. When disturbed she did not fly, but stayed around the cluster of eggs vibrating her antennae and wings rapidly. The eggs are circular, barrel like, metallic grey in color and are arranged regularly over the leaf surface. Specimens collected at Caracas and Turmero.

Mormidea ypsilon Linn.
On grasses at Maracay and La Providencia. Col. M. & S.

Nezara viridula Linn.
Fairly numerous on tomato plants in the vegetable garden at La Providencia.

Pahrypia pulchella Drury
At La Providencia.

COREIDAE

Acidomera rustica Stal
On grasses near Maracay.

Anasa bellator Fab.
Common on pigeon-pea, *Cajan Cajan* (L) Millsp., near La Providencia.

Catorhintha guttula Fabr.
On grasses, near Maracay and La Providencia.

Leptoglossus stigma H. S.
Common on tomato, at La Providencia. Also collected at Caracas.

Leptoglossus vexillatus Stal
Collected while resting on the leaves of *Clerodendrum fragans* Vent., at La Providencia.

Mozena lunata Brum.
Collected at La Providencia.

Zicca taeniola Dall.
Very abundant on corn plants near La Providencia and Turmero.

LYGAEIDAE

Oncopeltus cingulifera Stal
This species is very common on milkweed, *Asclepsias curassavica* L., not only at Turmero, La Providencia and Maracay, but also in Caracas.

Oncopeltus sandarachatus Say
Collected in Turmero, flying among grasses.

PYRRHOCORIDAE

Dysdrcus peruvianus Linn.
In corn plantations near La Providencia, Cagua and Turmero. Species extremely common on *Punica Granatum* L., in Caracas.

Dysdercus ruficollis Linn.
At Maracay.

Dysdercus sp.
Collected near Maracay, on weeds.

Euryophthalmus varians Stal
On coffee, near La Providencia.

TINGIDIDAE

Corythucha fuscigera Stal
On wild eggplant, *Solanum torvum* Sw., near Cagua.

Corythaica monacha Stal (Det. L. F. Martorell)
Very abundant on *Solanum Melongena* L., at the vegetable garden of the School of Agriculture. The undersides of the leaves were heavily infested with this insect.

REDUVIIDAE

Heza similis Stal
Common on corn plants, near La Providencia and Samán de Guere.

Rasahus hamatus Fabr.
On weeds, at La Providencia.

Zelus rubidus Lep. & Serv.
On leaves of *Clerodendrum fragans* Vent., and other weeds at La Providencia and at Cagua.

Zelus spp.
Very abundant on tomato, *Lycopersicon Lycopersicon* (L) Karst., at La Providencia.

CIMICIDAE

Cimex lectularius Linn. (Det. L. F. Martorell)
This cosmopolitan insect occurs in the whole region of Aragua; at Turmero, Maracay and La Providencia. Specimens had been observed in Caracas, Ocumare del Tuy, Los Teques and Tejerías. It is of common occurrence at boarding houses and unclean rooms.

MIRIDAE

Collaria sp. (Det. H. G. Barber)
On corn plants at La Providencia and Samán de Guere. The same species was collected in Caracas.

GERRIDAE

Gerris sp. (Det. L. F. Martorell)
Very abundant insect in pools of stagnant water and in the small streams around La Providencia, Maracay and Turmero.

NOTONECTIDAE

Belostoma anura H. S.
In pools near La Providencia. Attracted to bright light during the night.

Belostoma mayri Berg.
Attracted to lights, at La Providencia.

Belostoma micantula Stal
Fairly common in pools near La Providencia. Attracted to bright lights at night.

HOMOPTERA

CICADIDAE

The members of this family are very common in the Aragua region. They inhabit the forest and spend their lives singing morning and evening. Usually found resting on the trunks of such trees as *Mangifera indica* L., *Swietenia Candollei* Pittier, *Coffea arabica* L., and *Inga* spp. They are specially abundant during the rainy season. At Caracas, Los Teques and Antimano, they are also abundant even in the "patios", inside the houses.

Determinations in this family as well as in the Cercopidae, Membracidae, Cicadellidae, and Fulgoridae were made by H. Osborn of Ohio State University and P. W. Oman, of the National Museum.

Proarna grisea Fabr.
Rather abundant species in the Valley. Also collected at Caracas.

Calyira telifera Walk.
Collected near La Providencia.

Cicada pallida Dist.
Collected near Samán de Guere. Not a very common species.

Proarna germari Dist.
At Samán de Guere.

Quesada gigas Dist.
This gigantic cicada, sometimes with a wing expanse of 13 centimeters, is one of the most common species in the forest region of Aragua. Collected in great numbers during the rainy season. Very common at Caracas also.

Tympanoterpes serricosta Germ.
Fairly common in the surroundings of La Providencia.

CERCOPIDAE

Cephisus siccifolius Walk.
Collected near Samán de Guere by E. Serres.

Tomaspis varia Fabr. (Det. L. F. Martorell)
This insect is called in certain regions of Venezuela, the "fire-blight of the pastures" (la candelilla de los pastos), for grasses when badly infested look as if they were burned. Fortunately, they are not very abundant in Aragua. Collected near Turmero.

MEMBRACIDAE

Aethalion reticulatum Linn.
In Caracas the writer saw a camphor tree, *Camphora Camphora* (L) Karst., completely infested by this pest. Nearly all the branches were filled with mature and inmature stages of the insect. The inmature stages were in masses, along the branches. Recorded from La Providencia also.

Antianthe expansa Germ.
At La Providencia on grasses. Col. M. & S.

Ceresa vitulus Fabr.
In a coffee plantation, near Samán de Guere.

Ceresa sp.
Collected near Maracay. Col. E. S.

Enchenopa nutans Germ.
Collected near La Providencia by M. Palma.

Membracis albo-limbata Dist.
At Samán de Guere by E. S.

Membracis alta Walk.
On grasses at La Providencia.

Membracis c-album Fairm.
Collected near Turmero.

Polyglypta dorsalis (var.) Burm.
Collected near Maracay.

Sphongophorus ballista Germ.
A very uncommon species in the region. Collected in a coffee plantation near La Providencia.

Umbonia spinosa Fabr.
Many of the specimens in the collection were obtained in coffee plantations at La Providencia, Turmero and Los Teques. In this last place, the insects were doing damage to the shade trees of the genus *Inga.* The damage was caused by the female of the species, especially on the young shoots, where they bored small holes or crescent shaped slits to lay their eggs. Not only the tender shoots were attacked, but also the older ones.

Cicadellidae

Although these insects were very common in every place in the region, very few specimens are represented in the collection. Most of the specimens collected were attacked by moulds and were thrown away. The following only remain:

Cicadella maculicollis Sign.
A fairly abundant species in the region.

Cicadella spp.
Two different species under this genus are present, without further identification. These were collected on grasses, at La Providencia.

Oncometopia fusca Melichar
Collected at lights at La Providencia.

Fulgoridae

Copicerus irroratus Swartz
Attracted to lights at Lá Providencia.

Dictyophora sp.
On grasses in a coffee plantation near Samán de Guere. Col. M. & S.

Domitia neotropicalis Dist.
At La Providencia, by J. L. Maury.

Flatoides sp.
At lights. at La Providencia.

Ormenis sp.
On coffee trees, near Turmero and La Providencia.

Poeciloptera phalaenoides Stal.
On *Cajan Cajan* (L) Millsp., at La Providencia.

Aphididae

(Determinations in this family by L. F. Martorell.)

Aphis maidis Fitch
Very abundant in the corn plantations, near La Providencia, Turmero and Maracay. This species is also abundant at Caracas.

Aphis gossypii Glover
An extensive infestation in the vegetable garden at the School of Agriculture, on cucumbers and melons, especially on the former.

Brevicoryne brassicae Linn.
Very abundant on cabbage plants at La Providencia. Fortunately, no insecticides were needed for its control, for they were naturally controlled by the coccinellid, *Cycloneda sanguinea* Linn., which was very abundant at that time.

Coccidae

(All determinations in this group by L. F. Martorell.)

Ceroplastes floridensis Comstock
Very abundant in all kinds of *Citrus* near La Providencia, Turmero and Maracay. This scale has been recorded by the writer also from Caracas and Valencia (Estado Carabobo). On *Citrus sinensis* (L) Osbeck., *Citrus Aurantium* L., and *Citrus maxima* (Burm.) Merrill.

Chionaspis citri Comstock
Very common on all kinds of *Citrus* in the Aragua region, as well as in Caracas, Los Teques and Valencia.

Coccus hesperidium Linn.

From leaves of *Citrus* maxima (Burm.) Merrill. Collected at Valencia (Estado Carabobo) in the Hacienda of Coronel Fonseca and on coffee leaves at La Providencia.

Lepisdosaphes beckii Newman

Another pest of citrus orchards in Aragua, as well as in Caracas, Ocumare del Tuy, Río Chico, Los Teques, etc. At La Providencia, trees of sweet orange, *Citrus sinensis* (L) Osbeck., sour orange, *Citrus Aurantium* L., and *Citrus maxima* (Burm.) Merrill., were heavily infested on both twigs and leaves.

Pseudoccocus citri Risso.

Common on sweet orange at La Providencia and Maracay.

Pseudococcus longispinus Targ.

Abundant on sweet orange at La Providencia. Also on same host at Valencia. (Hacienda of Coronel Fonseca.)

Pseudococcus sacchari Cock.

Common in sugar-cane fields, near Turmero and at San Jacinto, Maracay.

Saissetia hemisphaerica Targ.

Common on *Citrus,* ferns and guava, *Psidium Guajava* L., also on *Solanum Melongena* L., at La Providencia. An ornamental plant, *Porana paniculata* Roxb., was heavily infested by this scale in Valencia.

Saissetia oleae Bernard

This scale, although not as common as the preceeding one, also attacks many plants, for example: wild eggplant, *Solanum torvum* Sw., guava, *Psidium Guajava* L., and *Ixora acuminata* Roxb. All these were found at La Providencia.

Toumeyella sp. (Det. H. Morrison)

This scale was found in small numbers in a coffee plantation near Turmero, and also on coffee roots in a plantation at Los Teques. The insects were very abundant in the infested trees and apparently they were in association with the hemispherical scale, *Saissetia hemisphaerica* Targ. The trees were turning yellow, then wilting and finally dying. Many hundreds of plants were infested in the same area. The specimens of the scales as well as the coffee roots were collected by Mr. Ríos, of Caracas.

Aleyrodidae

Dialeurodes sp. (Det. L. F. Martorell)
Common at La Providencia and Valencia, on sweet orange, sour orange and grapefruit.

COLEOPTERA

In the arrangement of this group the writer follows Charles Leng, in his work, "Catalogue of the Coleoptera of America, North of Mexico". (18)

Cicindelidae

(Determinations in this family as well as in the two following by L. L. Buchanan.

Megacephala affinis Dej.
Only two specimens were collected at lights.

Phaeoxantha aequinoctialis Dej.
At La Providencia.

Cicindela sp.
Quite common along the banks of small rivers and streams near La Providencia and Turmero. One specimen of this same genus was collected by H. Soltero, in the Orinoco River region (Estado Bolivar).

Carabidae

Brachinus sp.
Only one specimen collected at lights at La Providencia.

Calosoma alternans Fabr.
This is a very common carabid in the region. They are attracted to lights, during the night, especially during the rainy season. Collected at La Providencia and Turmero. Col. M. & S.

Pherosophus aequinoctialis L.
Collected near Samán de Guere under dead leaves, on the ground. Col. E. S.

Polpochila sp.
Under the bark of old trees and dry leaves on the soil, at Turmero and La Providencia.

Scarites sp.
At light at Cagua.

Selenophorus sp.

Under dry leaves and twigs, near Samán de Guere. Col. M. Palma and J. L. Maury.

Scythropasus sp.

Very rare. Collected near Turmero.

Hydrophilidae

Berosus sp.

Common in water pools near La Providencia. Col. M. & S.

Neohydrophilus medius Brullé

Common in nearly every pool of stagnant water in the surroundings of La Providencia and Turmero.

Stethoxus ater Fabr.

An extremely common species in water pools near La Providencia, Turmero and Maracay. Attracted to lights during the night. Col. M. & S.

Staphylinidae

Cordylaspis pilosa Nordm.

The only representative of this family in the collection was taken under the bark of a mango tree, *Mangifera indica* L., near Maracay.

Lampyridae

(Determinations in this family and in the two following by H. S. Barber.)

Aspisoma dilatatum Cast.

Collected beneath dry bark near Samán de Guere.

Aspisoma ignitum Linn.

On corn plants at La Providencia.

Aspisoma spp.

A series of specimens under this genus were collected, but further identification could not be made for lack of males. Collected near Samán de Guere and La Providencia.

Cratomorphus sp.

Not further identified for lack of male specimens. Collected at La Providencia.

Photuris sp.
Collected in corn plantations during night. Specimens retained in the U. S. National Museum.

Photinus sp.
A series of this beetles were collected of several different species. They are very common in the corn plantation near La Providencia and Turmero. During the night the fields are illuminated by glowing lights and thousands of these insects can be seen flying all over the place. A series was kept for further studies and identification in the U. S. National Museum.

CANTHARIDAE

Cantharis spp.
A series of these beetles was collected in the corn plantations near La Providencia. Very common during daytime, flying among the corn leaves. One specimen of this genus was collected at El Cedral, near Caracas, on *Coffea arabica* L. The species is new to the U. S. National Museum collection.

Diaphron proteum Gorh.
A series of about ten to twelve specimens were collected. This insect shows a wide range of variation in color. Collected on corn at La Providencia and also near Turmero. Col. M. & S.

MELOIDAE

Epicauta albicincta Haag.
Collected in the vegetable garden, flying among beets and chard, near La Providencia.

Epicauta grammica Fisch.
Very abundant in the surroundings of La Providencia and Samân de Guere, on weeds and grasses. Col. M. & S.

ELATERIDAE

(Determination in this family as well as in the **Buprestidae** by W. S. Fisher.)

Chalcolepidius limbatus Esch.
This gigantic click beetle was collected on a wild fern at El Cedral, near Caracas, at 1,500 meters in altitute and also at La Providencia, resting on the trunk of a shade tree of the genus *Inga*, in a coffee plantation. Col. Martorell, Serres and Aguilera.

Pyrophorus luminosus Illiger
Quite common at La Providencia, Cagua and Turmero. During the night they fly in the fields, and frequently are attracted to bright lights.

Pyrophorus ignitus Fabr.
At light, at Samán de Guere.

Drasterius sp.
Collected at La Providencia.

Dilobitarsus bidens Fabr.
On corn leaves, near Samán de Guere, by M. Palma.

Semiotus ligneus Linn.
Collected near La Providencia on coffee, during daytime, in a very shady spot of the plantation.

BUPRESTIDAE

Pachyscelus sp.
The species of the genus are leafminers. The specimen represented in the collection was taken at lights at Turmero.

Polycesta aequinoctialis Thoms.
At La Providencia.

Psiloptera (Lampetis) variolosa Fabr.
This beautiful, irridescent, metallic blue-green species is very common at La Providencia. The specimens were collected during flight.

DRYOPIDAE

Pelonomus sp. (Det. H. S. Barber)
Collected at La Providencia.

HELODIDAE

Ptilodactyla sp.
At La Providencia.

Telon cucullatus Champ.
A female specimen was collected at La Providencia. Apparently this Venezuelan female seems to be the third known, in the world. This insect was described in 1897 from a female collected in Panama. In the U. S. National Museum collection there is a specimen collected in Panama in 1909 and this is the third one.

Dermestidae

Anthrenus scrophulariae Linn. (Det. L. F. Martorell)
Attacking insect collections in Caracas and at La Providencia. About two hundred larvae were collected by the writer in the insect collection of the Ministry of Health and Agriculture in Caracas (Ministerio de Salubridad y de Agricultura y Cría).

Ostomidae (Temnochilidae, Trogostidae)

(Determinations in the **Ostomidae**, **Erotylidae** and **Endomychidae** by W. S. Fisher.)

Lophocateres pusillus Klug.
At La Providencia.

Tenebroides mauritanicus Linn.
On vegetable seeds stored at La Providencia. Also obtained from wheat, in Caracas and La Providencia.

Erotylidae

Brachysphaenus spp.
"This is a very wide genus, with approximately two hundred and fifty species described from different parts of the world, the majority of these being found in the northern part of South America. The species among themselves are very difficult to separate and the genus requires a revisional study before any attempts can be made to classify them. Moreover, there are four other genera which are scarcely distinguishable from *Brachysphaenus*, and the species among themselves are also badly confused. The specimens in the collection were all new to the U. S. National Museum, and were kept there for further studies. Apparently four different species are present in the series." Collected at La Providencia and Turmero, always on gill fungi.

Coccimorphus dichrous Lec.
Specimens collected on gill fungi, in a coffee plantation near La Providencia. Sometimes four or five adults were collected in a single mushroom.

Cypherotylus debauvei Demay.
This peculiar looking insect was collected at La Providencia and near Maracay. Col. M. & S.

ENDOMYCHIDAE

Ephebus cardinalis Gerst.
This is the only specimen representing the family in the collection. Taken on gill fungi with three other red beetles (*C. dichrous* Lec.) near Samán de Guere.

COCCINELIDAE

(Determinations in this family and in the **Tenebrionidae** by E. A. Chapin.)

Camptodes ? foreli ? Grouv.
At La Providencia on grapefruit leaves, *Citrus maxima* (Burm.) Merril.

Ceratomegilla maculata De Geer
Abundant species at the vegetable garden of the School of Agriculture at La Providencia. On cabbage, peppers, cucumbers and beans. Specimens also collected in Caracas.

Cycloneda sanguinea Linn.
The most common of all the coccinelids in the region. Found in almost any place, at La Providencia, Turmero, Cagua, Maracay, Ocumare de la Costa (Estado Aragua), at Ocumare del Tuy, Cúa, San José de Río Chico and Los Teques (Estado Miranda). The abundance of this species, in association with the preceeding one, kept the cabbage aphis under control at the vegetable garden of the School of Agriculture.

Epilachna borealis Fabr.
Very abundant on cucumber plants and beans, in the vegetable gardens at Maracay and La Providencia.

Exochomus sp.
On citrus trees in Caracas and La Providencia. Specimens retained by the U. S. National Museum.

Hyperaspis albicollis Gorh.
Collected on sour and sweet oranges at La Providencia and Turmero.

Hyperaspis sp.
On citrus leaves.

Pentilia insidiosa Muls.
On citrus trees at Turmero and La Providencia.

Psyllobora confluens Fab.

Very abundant in the Aragua region, in almost every citrus tree. Specimens collected at Turmero, La Providencia and Caracas. Col. M. & S.

Scymnus sp.

Collected near Turmero, on grapefruit.

TENEBRIONIDAE

Epitragus aurulentus Kirsch.

A very common species at La Providencia. Found under decayed leaves and twigs. One specimen was brought to the collection by H. Soltero, from the Orinoco River region (Estado Bolivar).

Strongylium sp.

Collected by E. Serres, near Samán de Guere.

Tribolium confusum Duval

Wheat and corn seeds badly infested at La Providencia. Also specimens from Caracas, on wheat.

Zophobas morio Fabr.

Several bags of grass seed were infested with this insect, in the store room of La Providencia. About twenty specimens were collected, the rest were destroyed. Col. Martorell & Maury.

Goniadera sp.

Collected at La Providencia.

BOSTRICHIDAE

Schistocerus cornutus Pallas (Det. W. S. Fisher)

This insect is a common borer in southwestern United States of America, where it attacks the twigs of fruit trees, such as grapes, almonds, figs, etc. The host tree in Aragua is unknown to the writer.

SCARABAEIDAE

(Determinations in this family and in the **Passalidae** by E. A. Chapin.)

The greater part of the specimens in the collection were obtained at night, at La Providencia. The economic importance of the species is unknown, but the presence of white grubs in great numbers was

noticed in the vegetable garden at La Providencia. Apparently they were not doing any considerable damage, in spite of their abundance. Most of the insects were collected during the rainy season, which perhaps is the most favorable time for flights of adults. The following is the list of the insects in the collection.

Anomala cincta Say
Collected at light. Col. J. G. Fortmann, at La Providencia.

Anomala cupricollis Chevr.
Not very abundant. Collected at light at La Providencia. Col. M. Palma.

Astaena sp.
At light at La Providencia and Turmero. Col. M. & S.

Canthidium sp.
Under dry leaves and twigs near Samán de Guere.

Canthon sp.
In cow dung in decomposition, near La Providencia.

Coelosis hippocrates B. L.
At light, at La Providencia.

Cyclocephala pallens ?
At light, at Turmero.

Cyclocephala testacea Burm.
Collected at light at La Providencia, by E. S.

Euethola humilis Burm.
A very common insect in the region. Attracted to lights. Specimens at La Providencia and Cagua.

Gymnetis dysoni Schaum.
Collected on banana leaf, *Musa sapientum* L., in a coffee plantation near Samán de Guere. There is a closely related species to this one in Venezuela, readily distinguishable from *G. dysoni,* by its grey color instead of the black underside. Col. L. Maury.

Gymnetis stellata Latr.
One specimen collected near Maracay, at San Jacinto.

Heterogomphus rugicollis Prell.

Rather common species in the region. Attracted to lights, at La Providencia and Turmero.

Leucothyreus minutus Ohaus.

Collected at light at Turmero.

Ligyrus fossor Latr.

The most common of all the scarabs in the region. Attracted to lights. Specimens from Maracay, Cagua, La Providencia and Caracas. One specimen was brought to the collection by H. Soltero from the Orinoco region (Estado Bolivar). Col. Serres, Soltero, Palma and Martorell.

Ligyrus sp.

At light at La Providencia.

Liogenys quadridens Fabr.

Common species in the vicinity of La Providencia. Attracted to lights.

Macraspis lucida Oliv.

Species collected in Samán de Guere and La Providencia. Col. M. & S.

Ontherus sp.

Collected under a bunch of banana leaves on the ground in a coffee plantation near La Providencia. Col. Martorell.

Onthophagus sp.

In decomposed organic matter, garbage, cow dung and soil. Also on wire screens at La Providencia and La Trinidad. Col. Serres, Maury and Martorell.

Pelidnota (Pelidnota) fuscoviridis Ohaus

One specimen collected at lights at La Providencia.

Pelidnota (Pelidnota) lucida Burm.

One of the most common scarabs in the region. Attracted to lights. Specimens from La Providencia, Turmero and Maracay.

Pelidnota (Chalcoplethis) chamaeleon Voet.

Fairly common. Collected at lights at La Providencia and Samán de Guere. Col. Serres and J. R. Jurado.

Pinotus sp.
Collected near Cagua.

Phileurus didymus Linn.
Collected at La Providencia.

Scaptophilus complanatus Burm.
Attracted to lights at La Providencia.

Strategus jugurtha Burm.
Collected at La Providencia.

PASSALIDAE

Passalus interruptus Linn.
Living in associations or colonies under decayed logs and humid places. A log, near Samán de Guere, showed a colony of thirty-five or forty of these beetles in adult and pupal stages. Also found at La Providencia and Turmero.

CERAMBYCIDAE

(Determinations in this family by W. S. Fisher.)

Acanthoderes circumflexa Jacq. Duval.
Collected at La Providencia, while resting on the bark of a mango tree, *Mangifera indica* L., by Martorell.

Cridion cinereum ? Oliv.
The most common of the long-horned beetles in the region. Collected at lights at Samán de Guere and La Providencia. "The identification of this particular species is doubtful, because both sexes are needed to separate the species correctly. There is another species, *Cridion antennatum,* described from Venezuela, which is supposed to have 12 joints in the antennae, but there are no specimens present in the Museum collection. One specimen was kept for future study."

Estola ignobilis Bates
Only one specimen collected near Cagua.

Ibidion sp.
This insect seems to be very common. There are four specimens in the collection and Mr. Serres has three more in his own collection. W. S. Fisher, of the National Museum says, "This species is not represented in our collection and I am

unable to identify it with the descriptions before me. This is a very large genus and the older species'' are badly confused under *Ibidion*, *Compsa* and *Heterachthes*.'' Col. Seres, Jurado and Martorell.

Lagochirus araneiformis Linn.

Only one specimen collected near Turmero and the other near Samán de Guere, in a coffee plantation, resting on the trunk of a guamá tree (*Inga* sp.).

Oncideres lebasi Dupont

One of the most common cerambycids in the region. Collected near Samán de Guere, Maracay and La Providencia. Col. M. & S.

Oncideres (Lochmaeodes) tessellata Thoms.

Collected near La Providencia, on flight.

Ptychodes trilineatus Linn.

This beautiful beetle, which is found also in the southern part of the U. S. of America, is an inhabitant of the Aragua region. The common name for it in North America is ''fig borer''. Only three specimens were collected, near La Providencia and Turmero. Col. Briceño and Serres.

Rhopalophora pustulosa White

One specimen collected at La Providencia.

Steirastoma brevis Sulzer

Collected during flight at Ocumare de la Costa. This insect is very common in the cacao regions of Miranda State, where it is supposed to do considerable damage to the cacao trees. The writer collected some specimens at Río Chico and San José de Río Chico (Estado Miranda).

Steirastoma histrionicum White

Three specimens are present at the collection. Two were collected at La Providencia and the third one in a cacao plantation, at San José de Río Chico, (Hacienda of General Gómez).

Stenodontes (Mallodon) dasystomus subsp. **bajulus** Er.

Collected at lights at Samán de Guere.

Trachyderes nigripes (var.)

At La Providencia.

CHRYSOMELIDAE

(Determinations in this family by H. S. Barber.)

Altica sp. near **amethistinus** Oliv.
This insect was collected from a weed of the genus *Sida*. The plant was infested with the beetles, and a series were taken and pinned. Unfortunately, all the specimens present were females, and males are needed for the exact identification. Collected near La Providencia by J. G. Fortmann.

Asphaera lunata (Fabr.)
On carrots. One specimen also was collected in Caracas and the rest at La Providencia. Col. M. & S.

Calligrapha sp.
Collected near Samán de Guere.

Chalcophana sp.
At La Providencia.

Chalepus spp.
On corn leaves, at La Providencia and near Samán de Guere.

Chelymorpha rufipennis Boh.
Collected near Maracay and La Providencia.

Chelymorpha sp.
Collected near La Providencia.

Chirida insubida Boh.
On sweet potato, near Samán de Guere. Col. M. & S.

Colaspis sp. near **prasina**
Very abundant in the region on grasses and on *Solanum Melongena* L.

Colaspis sp.
At La Providencia.

Coelomera sp. near **cayennensis**
Collected at La Providencia by M. Palma.

Diabrotica centralis Jac.
This species was very abundant on field beans.

Diabrotica sp. near **bivittata** Fabr.
Collected on cucumbers, *Cucumis sativus* L., at La Providencia. Very common on this crop.

Diabrotica speciosa ? Germ.
On grasses at Maracay.

Diabrotica viridis Fabr. (var.)
On weeds near La Providencia.

Diphaulaca aulica Oliv.
A pest of beets, *Beta vulgaris.*, and chard, *Beta* sp., in the vegetable garden of La Providencia. The young tender plants were the ones which suffered most. These beetles were extremely abundant. Col. Jurado and Martorell.

Disonycha austriaca Schauf.
On weeds, near Samán de Guere.

Disonycha glabrata Fabr.
On weeds, near Maracay and Samán de Guere.

Disonycha sp.
At La Providencia.

Epitrix sp.
On weeds, specimens from Maracay and La Providencia. Col. M. & S.

Eumolpus sophiae ? Kolbe
"The determination of this insect is doubtful, for all the male specimens were imature and its identification is uncertain. The specimen looks very much like *E. surinamensis* Fab., but it is not." This insect is another pest of beets and chard. Fortunately, they did not become abundant until the plants were mature. Very common at La Providencia.

Glyptoscelis fascicularis Baly
Collected at La Providencia.

Homophoeta sp.
Attacking field beans and beets at La Providencia.

Lactica scutellaris ? Oliv.
Collected on weeds near Maracay and at Samán de Guere. Col. M. & S.

Metriona judaica Fabr.
On weeds, near La Providencia.

Metriona 6-punctata Fabr.
On corn near La Providencia. Col. J. L. Maury.

Metriona sp.
Collected on grasses, near Turmero.

Myochrous explanatus Baly
Collected on weeds at Turmero.

Oedionychis decimguttata (var.) Fabr.
Common on field beans at La Providencia. One specimen from Caracas, also on beans. Col. M. & S.

Oedionychis spp.
Three different species of this genus are present in the collection. From La Providencia and Maracay, on grasses.

Oxyodera lanuginosa Boh.
Collected near Turmero.

Poecilaspis sp.
Collected near La Providencia.

MYLABRIDAE

Mylabris quadrimaculatus Fabr. (Det. L. F. Martorell)
Extremely abundant on field beans in Caracas, Maracay and La Providencia.

BRENTHIDAE

(Determinations in the **Brenthidae** and **Curculionidae** by L. L. Buchanan.)

Brenthus anchorago Linn.
Very common at La Providencia. All specimens collected during flight. Also one specimen from Caracas.

Brenthus armiger Hbst.
Only a few specimens collected near Samán de Guere. Col. E. S.

CURCULIONIDAE

Brachyomus ? 4-nodosus Klug.
Many collected on cacao, *Theobroma Cacao* L., at Río Chico, San José de Río Chico, where they were very common; some specimens at Ocumare de la Costa.

Compsus 18-signatus Champ.
At La Providencia. Col. M. & S.

Dynamis borassi Fabr.
This beautiful, large weevil was collected near Maracay. Col. M. Palma.

Geraeus sp.
On weeds near Samán de Guere.

Neocyphus sp.
Collected on guava, *Psidium Guajava* L., near la Providencia.

Phyrdenus sp.
Collected near La Providencia.

Sitophilus granaria Linn. (Det. L. F. Martorell)
Very common on corn in storage. All the bags were infested. Collected at La Providencia.

Sitophilus oryzae L.
On rice, in the storage rooms of La Providencia.

Sitophilus (Calandra) setulosa (var.) Gyll.
Collected on grasses, in the hills, near La Providencia.

Sternechus decussatus Chevr.
Collected near Samán de Guere. Col. J. G. Fortman.

Zabrotes subfasciatus Boh.
Collected on grasses at Cagua.

DIPTERA

Tipulidae

Tipula sp. (Det. C. T. Greene)
A fly of this genus is very common around La Providencia and Samán de Guere. It is found in shady places, flying very low by the sides of tree trunks. Sometimes three and four are found in the same place. The writer collected the same fly in a cacao plantation at San José de Río Chico, Estado Miranda.

Psychodidae

Psychoda sp. (Det. L. F. Martorell)
They are commonly found in dark, unclean toilet rooms at La Providencia, Turmero and Maracay.

CHIRONOMIDAE

Culicoides paraensis Goeldi

Of great economic importance, the only representative of this family in the region. This troublesome fly becomes a nuisance during the rainy season, attacking people with great aggressiveness and voracity. It is very abundant and initiates its attacks during the first hours of the morning as well as at dusk. Its common name among the people of the Valley is "jején".

The writer has noticed this insect not only in the region of the Valley (La Providencia, Gonzalito, Samán de Guere, Turmero, Maracay, La Trinidad) but also at Río Chico, San José de Río Chico, Cúa, Ocumare de la Costa, Ocumare del Tuy and Maiquetía.

CULICIDAE

This family is widely represented in the valley by a great number of species belonging to different genera. When Dr. Adolpho Lutz and Dr. Nuñez Tovar, published their works, (19–21) the vicinity of La Providencia, Turmero, Cagua and Maracay, etc., was heavily infested. The Government has since taken care of the situation and by means of drainage and canalization, etc., the number of mosquitoes has been considerably reduced. The writer tried to obtain specimens of *Anopheles*, in the surroundings of La Providencia, with negative results, for all the specimens obtained were *Culex*. This was due to the fact that with the establishment of the School of Agriculture in the place, the nearby ponds and swamps were carefully drained and filled with earth. Before this was done the place was a center of *Anopheles* infection and many cases of malaria were reported some four or five years ago.

The writer refers to the works of Dr. Lutz and Dr. Nuñez Tovar for discussion of this Family. The following are the species recorded from the regions of Aragua.

Anopheles albimanus Wied.

One of the most common species in Venezuela. Had been found in the Federal District, Aragua, Guarico, Falcón, Monagas and Carabobo. In Caracas (J. M. Romero Sierra, Col. 1 (06); in Camaguán (E. Carrizales, 1911); in Calabozo (C. Madera, 1911); in Coro (Comisión Rockefeller, 1917); in Maturín, Maracay, Guacara and La Rubiera (Núñez Tovar, 1911, 1916 and 1918). This species is one of the common vectors of the malarial organism in this country.

Anopheles apicimaculus Dyar & Knab.
Obtained from larvae collected at Rancho Grande (Estado Aragua). Was also collected by the Rockefeller Commission, in Coro, Estado Falcón.

Anopheles argyritarsis Rob-Desv.
The common name for this mosquito in Venezuela is "puyón". The most abundant culicid in the "pampas" or "llanos", during the rainy season. Had been collected in Aragua, Carabobo, Guárico and Monagas. In Cagua (M. Rangel, 1911), in Maturín and Caño Colorado (M. Núñez Tovar, 1911.) Supposed to exist in other States of the Republic. It is the principal vector of malarial organisms in Venezuela.

Anopheles pseudopunctipennis Theo.
This species, which is very similar to *A. punctipennis*, is also a vector of *Plasmodium*. Has been collected by Dr. Núñez Tovar, 1916, in Maracay and Mariara.

Anopheles punctipennis Say
Collected inside the houses in Aragua and Carabobo. In Maracay, Turmero and Güigüe (M Núñez Tovar, 1916). It is also a vector of the disease.

Anopheles tarsimaculatus Goeldi
Another malarial mosquito. Has been collected in Maracay (M. Núñez Tovar, 1916), Maracaibo and La Vela (Rockefeller Commission, 1917).

Aedes aegypti L.
This mosquito is the vector of the agent which causes the yellow fever and according to Legendre & Brumpt, may serve also as the intermediate host to the ethiological agent of "dengue" and also to *Filaria brancofti*. Supposed to exist in every town in the Republic, as well as in the open country.

Aedes (Howardina) sexlineatus Theobald
Collected by Dr. Lutz at Turmero and La Providencia.

Culex amazonensis Lutz
Collected at La Providencia by Dr. Lutz.

Culex imitator Theobald
Very common in the Aragua region. Specimens were collected by Martorell & Serres.

Culex (Carrollia) iridescens Lutz
Collected in Aragua by Dr. Lutz.

Dendromyia bicompressa Lutz
Described from specimens obtained at Turmero.

Dendromyia luteoventralis Theobald
Specimens collected by Dr. Lutz at Cagua.

Dendromyia personata Lutz
Collected by Dr. Lutz at La Hacienda La Guayabita (Estado Aragua).

Haemogogus equinus Theobald
Specimens obtained at La Providencia and Turmero by Dr. Lutz.

Mansonia pseudotitillans Theobald
From specimens collected by Dr. Lutz in Tucupito, Estado Aragua.

Megarhinus trinidadensis Dyar & Knab
Collected by Dr. Lutz in Aragua.

Megarhinus portoricensis Roeder
Collected by Dr. Lutz in Aragua.

Psorophora champerico Dyar & Knab
Found in Aragua by Dr. Lutz.

Psorophora cyanescens Coquillet
Very common near the city of Maracay. Collected by Dr. N. Tovar and Dr. Lutz, at the airport of this city.

Psorophora discrucians Walk.
Species common in Aragua and Carabobo. Collected by Lutz & Tovar.

Psorophora ferox Humboldt
Collected by Nuñez Tovar in 1910 and 1916 in Maturín and Maracay.

Psorophora funiculus Dyar
Collected at San Jacinto, Maracay by Lutz and Tovar.

Psorophora genumaculata Neiva
Collected by Lutz and Tovar in Aragua.

Psorophora lineata Humb.
A very common species in the vicinity of La Providencia, called by the people of the region "puyón". They fly in swarms at dusk and early morning. The bite of this insect is very painful. Specimens collected by M. & S.

Psorophora Lutzi Theobald
Collected by Dr. N. Tovar in Maturín (Estado Monagas) and in Maracay, 1910 and 1916.

Sabethoides chloropterus Humboldt
Collected by Lutz and Núñez Tovar at Turmero.

Trichoprosopon pusillum Lutz
Collected at Hacienda Guayabita, by Lutz and Tovar.

Uranotaenia pulcherrima Arribalzaga
Collected by Dr. Lutz and N. Tovar at Rancho Grande, Estado Aragua.

Wyeomyia celeanocephala Dyar & Knab
Collected by Dr. Lutz and N. Tovar at Rancho Grande, Estado Aragua.

SIMULIIDAE

All records from Dr. Adolpho Lutz's work, "Estudios de Zoología y Parasitología Venezolanas", published at Río de Janeiro, Brazil, in December 1928 (18). Nearly all the specimens collected are from Maracay, Turmero and El Limón.

Simulium incrustatum Lutz
This species has been observed in its three stages of metamorphosis by Dr. Lutz. Specimens were obtained near Maracay and at the Hacienda Guayabita, near Turmero. Attacks man, but has marked preference for equines.

Simulium lugubre Lutz & Tovar
Specimens collected by Dr. Lutz along the Maracay River and in the vicinity of La Providencia.

Simulium ochraceum Walker
Along the Limón River, by Dr. Lutz. This species does not attack man.

STRATIOMYDAE

Cyphonmyia leucocephala Wied.
On weeds near La Providencia.

Hermetia illucens Linn.
A common species at La Providencia.

Heteracanthia ruficornis Macq.
Flying around leaves of agave, *Agave americana* L., in the hills near La Providencia.

TABANIDAE

(Determinations in this family by A. Stone.)

Chrysops costatus Fabr.
This species is very common in the region, especially on horses, sometimes attacking man. Observed at Río Chico, San José de Río Chico, Cúa, Ocumare del Tuy (Estado Miranda), and also at Maracay, Caracas, Cagua, Turmero and La Providencia.

Dicladocera caloptera Schiner
Not represented in the collection, but cited by Dr. Lutz in his work. Females collected at Maracay.

Lepiselaga crassipes Fabr.
Not very common in the region. Only two specimens collected by E. S. and the writer at La Providencia. Dr. Adolpho Lutz, cites this insect in his work, from specimens collected at the Experimental Fields at Maracay.

Tabanus sp. near **albocirculus** Hine
This insect is very common in the region. Found on horses and cattle, in great abundance. Three specimens were collected at La Providencia and one at Maracay.

Tabanus ferrifer Walk.
Rather scarce. Collected at La Providencia, Cagua, and Turmero. Col. M. & S.

Tabanus leucaspis Wied.
Only one specimen collected by E. S. on wire screens, at La Providencia.

Tabanus testaceus Macq.
Specimens collected in Cagua.

Tabanus trilineatus Latr.
A fairly common species in nearly all the Valley.
Collected at La Providencia and Maracay by M. & S.

Asilidae

(Determinations in this family by C. T. Greene.)

Atomosia sp. near **puella** Wied.
Common in the coffee plantations near La Providencia and Turmero.

Erax sp.
Only one specimen collected by E. Serres at La Providencia.

Ommatius apicalis Schiner
On wire screen at La Providencia.

Promachus sp.
Fairly common in the region. The writer often observed one of these flies carrying a wasp in its jaws. The wasp was always of the same species, *Polybia fasciata* Sauss., which seems to be the favorite prey. Collected at Turmero and La Providencia.

Dolichopodidae

Psilopus sp. (Det. L. F. Martorell)
Flies of this genus are very common throughout the country flying among the leaves of coffee, bananas and plantains. Observed at El Cedral, near Caracas, 1,500 meter in altitude; at Cúa. Río Chico, San José de Río Chico (Estado Miranda), La Providencia, Samán de Guere, Turmero, Ocumare de la Costa (Estado Aragua). Col. M. & S.

Syrphidae

(Determinations in this family by C. T. Greene.)

Allograpta sp.
Collected in Maracay. Very common among flowering weeds. Col. M. & S.

Baccha sp.
These flies are very common in shady, humid places, under trees, in groups, flying suspended in space, while their wings are vibrating at high speed. In La Providencia and Samán de Guere. Col. E. S.

Meromacrus sp. near **panamensis**
A rare species in the region. Two specimens collected on wire screens, at La Providencia.

Toxomerus sp. near **geminata**

A very common fly in the corn fields in the vicinity of La Providencia, Gonzality and Turmero. Col. M. & S.

Toxomerus sp.

Common in corn fields. From La Providencia and Caracas.

Volucella esuriens Fabr.

This is the so called "Mexican cactus fly". The scavenger larvae feed on decayed cactus. The adult in the collection was taken at light at La Providencia.

Volucella obesa Fabr.

Abundant on the flower of citrus, *Citrus aurantium* L., *C. sinensis* (L) Osbeck and of *Chalcas exotica* (L) Millsp., at La Providencia and Caracas.

OESTRIDAE

Dermatobia cyaniventris Macq. **(Cuterebra noxialis Goud.)** (Det. L. F. Martorell)

Known as "gusano de monte" in nearly all the regions of Venezuela. Specimens reared from larvae obtained on cattle at Maracay, Cagua and Turmero.

TACHINIDAE

(Determinations in this family by J. M. Aldrich.)

Belvosia bicincta R. D.

This is the largest tachinid in the collection, measuring 15 mm. in length. The species is not very common in the region. Col. M. & S.

Calodexia sp. near **fasciata** Curran

One of the most common tachinids in the vicinity of La Providencia and Gonzalito. Col. E. S.

Leskiopalpus sp.

A common tachinid around La Providencia, Gonzalito and Turmero. Col. E. S.

Myiophasia globosa Tns.

Quite abundant at La Providencia and Gonzalito. Col. E. S.

Winthemia sp.

Abundant. Collected at Gonzalito, La Providencia and La Trinidad. Col. M. & S.

Sarcophagidae

The following specimens were determined by J. M. Aldrich of the National Museum.

Sarcophaga lambens Wd.
A very common species. Col. E. S.

Sarcophaga plinthopyga Wd.
Very common in garbage cans and kitchens at Gonzalito, Turmero and La Providencia.
The following three species were described by David G. Hall, Bureau of Entomology and Plant Quarantine, U. S. D. A., Washington, D. C., in his publication, "New South American Sarcophagidae (Diptera)", in the Journal of Agriculture of of the University of Puerto Rico, Vol. XXII, April 1938, pp. 171–176.

Sarcophaga camura Hall
Type from La Providencia, Maracay, Venezuela. Col. M. & S.

Sarcophaga rimosa Hall
Type from La Providencia, Maracay, Venezuela.

Abacantha (gen. nov.) **zygox** Hall
Type from La Providencia, Maracay, Venezuela. Col. Martorell.

Tripanurga albicans (Wiedemann)
One male and one female collected at La Providencia by M. & S.

Calliphoridae

(Determinations by J. M. Aldrich.)

Calliphora vomitoria L.
At La Providencia, Gonzalito and La Trinidad.

Cochliomyia macellaria Fabr.
A very common species at La Providencia and Gonzalito. Specimens were collected in the kitchens and in garbage cans, by E. S.

Hemilucilia fuscanipennis Mcq.
A rather abundant species at La Providencia and Gonzalito. Col. M. & S.

Lucilia spp.
Several species of this genus were collected in garbage cans, and on horse and cow manure, at La Providencia, La Trinidad, Gonzalito and Maracay, by M. & S.

ANTHOMYIDAE

(Determinations by J. M. Aldrich.)

Clinopera sp.

Collected while flying among weeds at La Providencia. Col. M. & S.

Limnophora sp.

One specimen collected by E. S. on wire screens at La Providencia.

Morellia scapulata Big.

Observed at La Trinidad, La Providencia, Gonzalito, and Turmero. Commonly found flying around garbage cans, manure and kitchens, as well as on wire screens. Col. M. & S.

Morellia violacea Fabr.

Very similar to the preceeding species. Collected on wire screens by E. S.

Musca domestica L.

Found in all the Aragua region, as well as in Caracas (Distrito Federal), Los Teques, Cúa, Ocumare del Tuy, Río Chico, San José de Río Chico, Carenero and Paparo (Estado Miranda).

The abundance of this insect was more noticeable during the rainy season, at least at La Providencia, Maracay and Turmero. Specimens from the places named above. Col. M. & S.

Neomuscina tripunctata V. d. W.

A rather abundant species at La Providencia. Col. E. S.

Stomoxys calcitrans Linn.

Found in stables and surroundings at La Providencia, Turmero, Cagua, Maracay and La Trinidad. Col. M. & S.

ORTALIDAE

(Determinations by J. M. Aldrich.)

Euxesta sp.

Flies of this genus are very common in La Providencia, Turmero and Maracay, flying around decomposed cow and horse manure, and rotten stumps, usually in shady places. Also very abundant on corn plants.

Pterocalla tarsata Schiner

Quite abundant on tree trunks, fence posts and in shady places. The species is very peculiar in its habits. When from ten or fifteen in a group, flying very low and close to the surface of tree trunks and posts, alight they walk slowly, always keeping their wings in a constant slow motion. Specimens collected at La Providencia by E. S. & José L. Maury.

Richardia podagrica Fabr.

Not every common, one specimen collected by E. S., at La Providencia.

Stenopterina brevipes Fabr.

A common species. Collected near Turmero by E. S.

PIOPHILIDAE

Piophila sp. (Det. by J. M. Aldrich)

In garbage cans. Very common at La Providencia. Col. E. S.

RHOPHALOMERIDAE

Rhophalomera sp. (Det. by J. M. Aldrich)

At La Providencia by M. & S.

TRYPETIDAE

(Determinations by C. Greene.)

Anastrepha striata Schiner

This species is very common in the region. It seems to be widely distributed through many sections of the country, for the writer has had the opportunity to obtain adults from larvae infesting fruits in different parts of Venezuela.

In the city of Caracas (1,000 meters in altitude), the pupal stage of the fly under laboratory conditions varies from 11 to 14 days. At Maracay and San José de Río Chico the pupal stage period is reduced a little, due to the higher temperatures in these low places. The fly was reared from the following hosts: guava, *Psidium Guajava* L., malayan apple, *Jambos malaccensis* (L) D. C., sweet orange, *Citrus sinensis* (L) Osbeck and *Prunus persica* (L) Stokes, in Caracas; *Psidium Guajava* and *Prunus persica,* at El Cedral 1,500 meters in altitude, (Hacienda of Mr. Luis París); *Psidium Guajava,* at La Providencia, Turmero, Cagua and Maracay; *Psidium Guajava,* and *Citrus sinensis,* at San José de Río Chico, Río Chico, Ocumare del Tuy and Cúa.

Ceratitis capitata Wied.

From a peach, *Prunus persica* (L) Stokes, bought by the writer at Caracas, ten fruit fly larvae were obtained. Several pupae were formed, but only one adult fruit fly emerged, which was determined by C. T. Greene, of the National Museum.

This is not the first record of the Mediterranean fruit fly in Venezuela as in the Service Regulation Announcements of the Plant Quarantine and Control Administration, U.S.D.A., published in 1931, on page 242, the record is given of this fly being intercepted at the San Juan Harbor from peaches in baggage of a transit passenger coming from Venezuela.

On requesting further information concerning this interception from the San Juan Office of the Bureau of Entomology and Plant Quarantine, it was found that a passenger on board the S. S. "Caracas" en route to New York, on 9–10–31, carried 23 peaches in his baggage. These were confiscated and destroyed after examination. The inspector reported 25 per cent of the peaches as infested and sent 5 larvae to Washington. These were identified by C. T. Greene as *Ceratitis capitata* Wied.

Hexachaeta sp.

On wire screens, by E. S.

Toxotrypana curvicauda Gerst.

Two adults reared from larvae infesting papaya, *Carica Papaya* L., at La Providencia. The fly does not seems to be very common in the Araguan orchards. Infested fruits were observed also in Ocumare del Tuy full of immature larvae.

Micropezidae

Grallomyia flavipes Mcq. (Det. by J. M. Aldrich)

Flying in abundance around tree trunks in shady places, near La Providencia and Turmero. Col. Serres and Maury.

Sepsidae

Sepsis sp. (Det. by J. M. Aldrich)

Specimens collected on wire screens at La Providencia by M. & S.

Drosophilidae

Drosophila sp. (Det. by L. F. Martorell)
Very abundant in the region. Seen on rotten fruits such as mangoes, bananas, oranges, etc., at La Providencia, Maracay, Caracas, Río Chico, San José de Río Chico, Cúa and Ocumare del Tuy.

Hippoboscidae

This family is represented in the Valley by the following species according to the studies of Dr. Lutz. The writer only had the chance to observe the presence of the species which attacks the common pigeons.

Lynchia palustris L. M. & C. L.
On egrets.

Lynchia raptatorum Lutz, Nieva & Costa Lima.
A common species on hawks.

Microlynchia pusilla Speiser
On wild pigeons.

Olfersia bisulcata Macq.
On ''zamuros'', (Turkey vultures.)

Pseudolynchia maura var. **lividicolor** Big.
Very abundant on domestic pigeons. This insect transmits the disease called pigeon malaria, caused by the protozoan, *Haemoproteus columbae* Celli and San Felice.

SIPHONAPTERA

(Determinations in the group by L. F. Martorell.)

Echinophagidae

Tunga pentrans Linn.
Extremely abundant in Maracay, La Providencia and Ocumare de La Costa. Also found in Caracas and San José de Río Chico. In this last place the writer checked the presence of the insect by personal experience.

Pulicidae

Ctenocphalus canis Curtis
On dogs in the Aragua region. Also found at Caracas.

Ctenocephalus felis Bouché
On cats at La Providencia.

Pulex irritans Linn.
Found on dogs and men.

LEPIDOPTERA

Most of the Lepidoptera in the collection were taken at light, others reared from larvae and some collected during flight in the fields. In the systematic arrangement of the group, the writer follows Barnes and McDunnough's, "Check List of the Lepidoptera of Boreal America". (2)

All determinations in this order made by William Schaus, except as otherwise noted.

Papilionidae

Papilio sp. (Det. L. F. Martorell)
At Caracas, on grapefruit trees.

Pieridae

Callidryas (Catopsilia) eubule Linn. (Det. L. F. Martorell)
At La Providencia they fly around ornamental plants, and zinnias, *Crassina elegans* (Jacq.) Kuntze. Also in the fields at Maracay and Turmero.

Pieris elodia Bdv.
In pastures and among weeds at La Providencia, Turmero and Caracas.

Pieris monuste Linn. (Det. L. F. Martorell)
The worst pest of cabbages in the region of Aragua. A whole cabbage plantation at Caracas was destroyed by these insects. Nearly all the specimens in the collection were reared from chrysalids obtained at the cabbage fields in Caracas, La Providencia, and Río Chico. Col. Guiscafré and Martorell.

Danaidae

Danaus menippe Hübner **(Anoxia plexippus)**
A very common butterfly in Maracay, Turmero, La Providencia and also in Caracas.

Lycorea cleobaea var **atergatis** Doub. & Hew.
Near La Providencia.

NYMPHALIDAE

Ageronia marsina Fruhst.

Only one specimen of this beatiful butterfly was collected while flying low through the coffee plantation at La Providencia. Col. M. Betancourt.

Callicore clymena Hubner.

One specimen collected while flying through weeds of the genus *Sida*. Col. E. S.

Chlosyne saundersi Db. & Hew.

Flying among flowers in the garden, of the School of Agriculture.

Junonia genoveva Cramer, (Det. L. F. Martorell)

A common species through all the Aragua region and also in Caracas.

Heliconius antiochus Linn.

Collected while flying through the coffee plantation of La Providencia. Not very common. Col. M. Palma.

Morpho sp.

Butterflies of this genus are common in the Aragua region, especially in mountainous places, but are every difficult to collect. At the coffee plantation near La Providencia, they were very abundant, flying in shady places below trees, also at Petare, in Caracas.

Pteronymia asopo Felder.

At La Providencia attracted by zinnia, *Crassina elegans* (Jacq.) Kuntze. This species is as common as *Callidryas eubule* Linn.

Pteronymia fulvescens C. & S.

This species is not so common as the preceeding, but occurs in the same places. At La Providencia and near Turmero.

HESPERIIDAE

Epargyreus socus Hübner.

At La Providencia.

Eudamus proteus Linn. (Det. L. F. Martorell)

A very common species at La Providencia, Turmero and Maracay. Specimens in the collection also from Caracas.

Erycinidae

Anteros formosus Cram.
Collected near Samán de Guere.

Rhiodinidae

Rhetus laonome Morisse
Collected near La Providencia, while flying very low among weeds.

Sphingidae

Amplypterus gannascus Stoll.
At lights at La Providencia.

Erinnyis ello Linn. (Det L. F. Martorell)
Attracted to lights in great numbers. The caterpillar of the species feeds upon the leaves of cassava, *Manihot Manihot* (L) Cock. One specimen was reared from a caterpillar collected while feeding on this plant, near Turmero. Col. M. & S.

Herse cingulata Fabr. (Det. L. F. Martorell)
At lights at La Providencia. One specimen from San José de Río Chico (Estado Miranda). Col. Martorell & Palma.

Phlegethontius occulta Roths. & Jord.
One specimen collected at lights at La Providencia.

Pholus labruscae Linn.
A fairly abundant species in Aragua. One specimen also from Caracas. Col. Martorell & Aguilera.

Saturniidae

Arsenura armida Cramer.
At lights at La Providencia. Fairly abundant.

Automeris auletes Bdv.
At lights at La Providencia.

Automeris angulatus Conte.
At lights at La Providencia. Col. A. Escalona.

Automeris pamina Newn.
Probably var. *aurosea* Newm. Very common at La Providencia. Collected at lights here and at Turmero.

Hylesia falcifera Hübn.
Common in the region. Specimens from Samán de Guere, Turmero and La Providencia. Col. Serres, Maury & Martorell.

Hylesia margarita Dogn.
At lights at La Providencia.

Hylesia mortifex Dyar.
Not very abundant. At lights at Samán de Guere. Col. M. Betancourt.

Ormiscodes nora Druce.
Rather common at La Providencia and Samán de Guere.

Syssphingidae

Adelocephala anthonilis H. S.
At lights at La Providencia.

Citheronia phoronea Cram.
At lights at Samán de Guere.

Eacles magnifica Walk.
Fairly common in the region. At Samán de Guere and La Providencia.

Syssphinx molina Cram.
At lights at La Providencia. Col. Palma & Serres.

Amatidae

Cyanopepla alonzo Butl.
Flying among weeds in shady places, under strees, near Samán de Guere.

Dinia mena Hübner.
Attracted to light, at La Providencia. Col. J. G. Fortmann.

Macrocneme leucostigma Perty.
Collected from weeds at La Providencia.

Arctiidae

Ammalo helops Cram.
At light at La Providencia.

Diacrisia alcumena Berg.
At light at La Providencia.

Ecpantheria muzina Oberthur.
Collected during daylight at Samán de Guere.

Utetheisa sp. (Det. L. F. Martorell)
Flying among *Crotalaria* sp. and *Cajan Cajan* (L) Millsp., near La Providencia and Turmero.

Noctuidae

Heliothis obsoleta Fabr. (Det. L. F. Martorell)

The caterpillar of this moth attacked the corn plants, at La Providencia and near Turmero. Nearly 50 per cent of the ears were badly attacked by the pest. Several specimens were reared.

Noropsis hieroglyphica Cramer

Collected at light at La Providencia. Col. M. & S.

Pericopidae

Pericopis sacrifica Hübn.

At light near Samán de Guere.

Limacodidae

Perola invaria Walker

Fairly common at La Providencia. Very abundant at light.

Megalopygidae

Megalopyge lanata Stoll.

At La Providencia.

Megalopyge nuda Stoll.

Collected near Samán de Guere.

Norape variabilis Hopp.

This is a small white moth which is very common in the region. It is attracted to light in great numbers. Specimens from Samán de Guere and La Providencia.

Pyralidae

(Determinations in this family by L. F. Martorell.)

Diatraea saccharalis Fabr.

The caterpillar is the sugar cane stalk borer, commonly found in sugar cane regions of the country. Very common in Aragua, as well as in Caracas, Río Chico, San José de Río Chico, Ocumare del Tuy and San Casimiro.

Hypsipyla grandella Zeller

Attacking Mexican cedar and Spanish cedar, *Cedrela mexicana* Roem. and *Cedrela odorata* L., in Caracas and Maracay. A great pest of young cedar trees, not only in this region but also in many South and Central-American countries. Adults reared from larvae.

Margaronia nitidalis Cram.

The caterpillar of this completely destroyed the last crop of cucumbers, *Cucumis sativus* L., in the vegetable garden at La Providencia. As many as 8 or 9 larvae were counted in a single fruit.

Margaronia hyalinata Linn.

One specimen collected at lights at La Providencia. Col. J. L. Maury.

GELECHIIDAE

Sitotroga cerealella Oliv.

Very common in La Providencia in the seed store room, attacking corn and wheat. Also observed in Caracas.

COSSIDAE

Xyleutes pyraemon Cram.

At lights at La Providencia.

HYMENOPTERA

In the discussion of this group the writer follows the systematic arrangement presented by E. O. Essig, in his book, "Insects of Western North America". (10)

ICHNEUMONOIDEA

(Determinations for **Braconidae** and **Ichnumonidae** by C. F. W. Muesebeck.)

BRACONIDAE

Alysia analis Cress.

From weeds at Turmero.

Iphiaulax sp.

At La Providencia.

ICHNEUMONIDAE

Bassus sp.

On weeds, at La Providencia.

Ephialtes sanguineipes Cress.

At Samán de Guere.

Monarea sp.

Collected near La Providencia.

CHALCIDOIDEA

CHALCIDIDAE

Bephrata maculicollis Cam. (Det. A. B. Gahan.)

Collected at La Providencia. While the writer was stationed at Caracas, several soursops, *Annona muricata* L., were observed infested with this insect, from which adults and pupae were obtained.

Brachymeria mexicana Dalla Torre. (Det. A. B. Gahan.)

Collected near Samán de Guere. Col. E. S.

FORMICOIDEA

FORMICIDAE

(Determinations in this family by W. M. Mann, Director, National Zoological Park.)

Atta sexdens Linn. (Det. L. F. Martorell)

The most dangerous pest of nearly all crops in the Aragua region and in nearly all Venezuela. This ant is very common near La Providencia, Turmero, Cagua and Maracay. The native name for the ant is "bachaco". A whole nursery of 500 small citrus plants were devoured in a single night by these ants.

The nests are deep and long, sometimes reaching 50 or 60 yards underground. They were very successfully controlled by flooding their underground nests with water from the irrigation canals. This insect seems more abundant during the dry season, but they do most damage during the rainy months when there is plenty of plant food to satisfy their voracity.

Eciton burchelli Westw.

Very common near Samán de Guere, running over the ground. Some species are also from La Hacienda, La Estrella, near Petares, Estado Miranda.

Eciton vagans Oliv.

At La Providencia and Turmero. Col. M. & S.

Eciton sp.

Several specimens of this genus are present in the collection, all of them winged. Usually after a rainy spell these insects fly out of their nests in great swarms, during the late hours of the day, 3 o'clock or later.

The writer never saw one of these swarms during the morning hours. The insects were so abundant that the tennis courts of the School of Agriculture, had to be cleaned to play on them. As soon as these winged adults alighted on the ground, each began to make a nest. It started by taking soil from a certain spot, until a small hole is made, going inside the hole, and in a few seconds, returning with a small amount of earth between its jaws. This is done repeatedly until a small but deep nest is completed with a fairly large mound of earth surrounding it.

Camponotus sp.
Common in the region. At La Providencia and near Samán de Guere.

Dolichoderus (Monacis) bispinosus Oliv.
Collected near Maracay.

Ectatoma ruidum Roger.
At Turmero.

Neoponera villosa Fabr.
This species is extremely abundant at Samán de Guere. They sting like wasps. One specimen from Turmero also. Col. Palma & Martorell.

SPHECOIDEA

Tachysphex sp. (Det. G. Sandhouse)
At La Providencia.

BEMBECIDAE

Bembecinus sp. (Det. G. Sandhouse)
At La Providencia.

EVANIIDAE

Evania appendigaster L. (Det. R. A. Cushman)
Not very common. One specimen obtained at La Providencia.

VESPOIDEA

SCOLIIDAE

(Determinations for this family and the next ones by G. Sandhouse.)

Campsomeris costalis (Lep.)
Collected near La Providencia.

Campsomeris dorsata (Fabr.)
Very common near La Providencia and Turmero. Flying among weeds. Male and female specimens in the collection.

MUTILLIDAE

Traumatomutilla sp.
Only one specimen collected near Samán de Guere.

PSAMMOCHARIDAE

Pepsis sp.
Common in the region.
Collected near Saman de Guere.

VESPIDAE

Apoica pallida (Oliv.)
Found dead near a glass panel, on a window at La Providencia.

Megacanthopus indeterminabilis var. **basimacula** (Cameron)
At La Providencia. A very abundant species.

Parachartergus colobopterus Web.
Collected near Samán de Guere. Col. Serres and Martorell.

Polistes canadensis Linn.
These wasps are called horse killers by the people of the vicinity, perhaps because they are very large and their sting is very painful. Very common in the Aragua region. Collected in Turmero, La Providencia and near Maracay. Col. M. & S.

Polybia diguetana Buysson
At La Providencia.

Polybia fasciata Sauss.
Commonly called "carniceras" (butchers). Their sting is very painful. Some specimens in the collection are from San José de Río Chico (Estado Miranda).

Polybia nigra Sauss.
This is a domestic social wasp which often makes its nest inside houses and buildings. At La Providencia they are a real nuisance in the classrooms and living rooms. Observed at Turmero, Maracay and Caracas.

Polybia occidentalis (Oliv.)
Common at La Providencia and Turmero.

Polybia occidentalis var.
Collected near Samán de Guere.

Polybia sericea Fabr.
Fairly abundant in the vicinity at La Providencia.

Synoeca surinama var. **cyanea** (Fabr.)
This beautiful, large, black wasp, is very abundant at La Providencia and Maracay. Also one specimen collected in Caracas.

APOIDEA

Euglossidae

Euglossa variabilis Friese
Collected visiting a flower of *Punica Granatum* L., at La Providencia.

Andrenidae

Agapostemon nasutus Smith
On flower of *Punica Granatum* L., at La Providencia.

Meliponidae

Trigona cupira Smith
On flowers of *Punica Granatum* L., at La Providencia.

Trigona silvestriana Vachal.
On flowers near La Providencia and Samán de Guere. Col. M. & S.

Nannotrigona testaceicornis (Lep.)
From weeds near Turmero. Col. E. S.

Apidae

Apis mellifera Linn.
Collected near an apiary at Gonzalito. Beekeeping is a small industry in many parts of the State. Near Maracay, at a Catholic School directed by German monks, beekeeping has been an industry for many years. Every year an abundance of honey and wax is obtained from these apiaries and sold for local use. In Caracas also there are commercial apiaries.

Bombus kohlii Cockerell
Collected at La Providencia.

Ceratina laeta Spin.
On flowers of *Punica Granatum* L., at La Providencia.

Ceratina sp.
Collected as the preceeding species.

Melipona interrupta var. **oblitescens** Cock.
Very common among weeds near Samán de Guere and La Providencia.

Tetralonia spp.
From weeds near La Providencia and Samán de Guere.

NEUROPTERA *

ASCALAPHIDAE

Ululodes cajennensis Fabr.—(det. Nathan Banks)
At Caracas and at La Providencia.

* Record received too late for insertion on p. 185.

ADDITIONAL INSECT RECORDS FROM VENEZUELA

By LUIS F. MARTORELL and ANSELMO ESCALONA SALAS.

In May 1935, the junior author, a student at the Agricultural and Mechanical College at Mayagüez, P. R., returned to Venezuela on vacation and while there, collected insects in the vicinity of Maracay, State of Aragua, which were brought to Puerto Rico.

A year later, in May of 1936, Escalona went to Valera, Estado Trujillo. The climatological conditions of Valera are indicated by the following rainfall data:

Year	Total Precipitation	Months Recording Most Rainfall
1935	34 29 inches	May and August
1936	36 31 inches	May, October and November
1937	24.77 inches. (Three months lacking)	March, May and October

The meteorological station is at Trujillo, Capital of the State. (12, 13, 14) Valera is a nearby town about 25 kilometers from Trujillo with not much difference in rainfall.

Escalona collected in the vicinity of Valera, in the fields and sometimes during the night at lights.

During the month of August 1937, the senior writer, returning to Venezuela, visited the State of Monagas, in the region around Maturín, Caripito and Quiriquire, to collect parasites of the mole cricket. During spare time at nights, and when conditions were not suitable for collecting parasites, the writer made collections of other insects. All the insects collected were on *Borreria verticillata* (L.) Meyer, unless otherwise specified.

Martorell stayed at Quiriquire, as well as in Caripito and Maturín. Quiriquire and Caripito are surrounded by a dense forest, with an immense variety of trees and flowering plants. The annual average rainfall for this region, as recorded by the station at Maturín, is around 45 inches. The region around Maturín is part forest and part "chaparrales" and savannahs. "Chaparral" is the term used by the natives, meaning a sort of savannah, covered by grasses and low, twisted trees like "curata" (*Curatela americana* L.) "alcornoque" (*Bowditchia virgilioides* H. B. K.) the very common

"chaparros" (*Byrsonima crassifolia* H. B. K. and *B. coccolobaefolia* H. B. K.) The region around the Quiriquire airport is very typical of a "chaparral"

Some of the insects were determined by the senior author, others were sent to the U. S. National Museum for determination.

The initials of the collectors, L. F. M. for Luis F. Martorell and A. E. S. for Anselmo Escalona Salas, identify the collections made by each. The insect names preceded by an asterisk in this paper, are already noted in the previous list, "Insects observed in the State of Aragua, Venezuela, S. A."

DERMAPTERA

* **Doru lineare** (Esch.) Det. A. B. Gurney
Col. A. E. S., Valera; May, 1936.

ORTHOPTERA

Blattidae

* **Blaberus trapezoideus** Burm.
Col. A. E. S.. Valera; May, 1936.

Panchlora cubensis Sauss.
Col. A. E. S., Maracay; May, 1935.

Gryllidae

Eneoptera surinamensis (DeGeer) (Det. A. B. Gurney)
One nymph collected by L. F. M., Caripito; August, 1937.

HEMIPTERA

HETEROPTERA

Cydnidae

Cyrtomenus teter Spin. (Det. H. G. Barber)
Col. A. E. S., Maracay; May, 1935.

Galgupha schultzii Fabr. (Det. H. G. Barber)
Col. L. F. M., Caripito, Maturín and Quiriquire; August, 1937.
Collected on *Borreria verticillata* (L.) Meyer.

Galgupha vinculata Germ. (Det. H. G. Barber)
Col. L. F. M., Maturín; August, 1937. *On Borreria verticillata* (L.) Meyer. Probably the most abundant insect on the weed.

* **Scaptocoris terginus** Schioedte (Det. Martorell)
Col. A. E. S., Maracay; May, 1935.

PENTATOMIDAE

(Determinations in this family as well as in the **Coreidae**, **Lygaeidae**, **Miridae**, **Pyrrhocoridae** and **Reduviidae** by H. G. Barber, unless otherwise noted.)

Agonosoma trilineata Fab. (var.)
Col. A. E. S., Maracay; May, 1935.

* **Chlorocoris depressus** Fabr. (Det. L. F. Martorell)
Col. A. E. S., Maracay; May, 1935.

* **Edessa rufomarginata** Dej. (Det. L. F. Martorell)
Col. A. E. S., Maracay; May, 1935.

Empicoris sp.
Col. A. E. S., Maracay; May, 1935.

Euschistus crenator Fab.
Col. A. E. S., Valera; May, 1936.

Lobothyreus lobatus Westw.
Col. A. E. S., Valera; May, 1936.

Loxa sp. (Det. L. F. Martorell)
Col. A. E. S., Maracay; May, 1935.

* **Mecistorhinus tripterus** Fab. (Det. L. F. Martorell)
Col. A. E. S., Maracay; May, 1935.

* **Mormidea ypsilon** Linn. (Det. L. F. Martorell)
Col. A. E. S., Maracay; May, 1935.

Thyanta casta Stal
Col. L. F. M., Caripito; August, 1937.

COREIDAE

Catorhintha selector Stal
Col. A. E. S., Maracay; May, 1935.

Hypselonotus fulvus Deg.
Col. A. E. S., Valera; May, 1936.

Hypselonotus fulvus venosus Fabr.
Col. L. F. M., Caripito and Maturín; August, 1937.

Margus obscurator Fab.
Col. L. F. M., Caripito; August, 1937.

* **Mozena lunata** Burm. (Det. L. F. Martorell)
Col. A. E. S., Valera; May, 1936 and Maracay; May, 1935.

LYGAEIDAE

* **Oncopeltus cingulifera** Stal
Col. L. F. M., Maturín and Caripito; August, 1937.

Orthaea bilobata Say
Col. L. F. M., Caripito; August, 1937.

Ortholomus jamaicensis Dall
Col. L. F. M., Caripito; August, 1937.

Paromius longulus Dall
Col. A. E. S., Valera; May, 1936.

PYRRHOCORIDAE

Dysdercus sp.
Nymph collected by A. E. S. at Valera; May, 1936 and Maracay; May, 1935.

REDUVIIDAE

Brontostoma sp.
Col. A. E. S., Maracay; May, 1935.

Leogorrus formicarius Fab.
Col. A. E. S., Valera; May, 1936.

MIRIDAE

Polymerus sp.
Col. L. F. M., Caripito; August, 1937.

NOTONECTIDAE

* **Belostoma anura** H. S.
Col. A. E. S., Maracay; May, 1935.

* **Belostoma micantula** Stal
Col. A. E. S., Maracay; May, 1935.

HOMOPTERA

Cicadidae

(Determinations in the suborder by P. W. Oman.)

Fidicina sp.
Col. A. E. S., Valera; May, 1936.

Proarna sp.
Col. L. F. M., at lights, at Caripito; August, 1937.

* **Proarna grisea** Fab.
Col. A. E. S., Maracay; May, 1935.

* **Quesada gigas** Oliv.
Col. A. E. S., Maracay; May, 1935.

Cercopidae

Tomaspis rubra var. **sororia** Germ.
Col. L. F. M., Caripito; August, 1937.

Membracidae

* **Aethalion reticulatum** Linn.
Col. A. E. S., Maracay; May, 1935.

Boethoos ? sp.
Col. A. E. S., Valera; May, 1936.

Cyphonia clavata Fabr.
Col. A. E. S., Valera, 1936.

Enchenopa concolor Fairm.
Col. G. N. Wolcott; Macuto, Venezuela; July, 1926. (See *Trigona ruficrus corvinus* Ckll.)

Enchophyllum malaleucum Walk.
Col. L. F. M., Caripito and Quiriquire; August, 1937.

Gelastonia sp.
Col. L. F. M., Caripito; August, 1937.

Cicadellidae

Acrogonia flavoscutellata Sign.
Col. A. E. S., Maracay; May, 1935.

Carneocephala sp.
Col. L. F. M., Caripito; August, 1937.

Dilobopterus sp.
Col. A. E. S., Valera; May, 1936.

Xerophloea viridis Fabr.
Col. L. F. M., Caripito; August, 1937.

FULGORIDAE

Flatoides sp.
Col. L. F. M., Caripito; August, 1937.

Laternaria phosphorea L. (Det. Martorell)
Col. A. E. S., Valera; May, 1936 and Francisco Seín, (1933), San Cristóbal, Estado Tachira. This makes two records in Venezuela, of the so called ''great lantern fly of Brazil''.

COLEOPTERA

CARABIDAE

(Determinations in this family by L. L. Buchanan.)

Arthrostictus chlaenoides Dej.
Col. A. E. S., Maracay; May, 1935.

* **Brachinus** sp.
Col. A. E. S., Maracay; May, 1935.

Calleida amethystina F.
Col. A. E. S., Valera; May, 1936.

Coptia armata Cast.
Col. A. E. S., Maracay; May, 1935.

* **Scarites** sp.
Col. A. E. S., Valera; May, 1936.

* **Scythropasus** sp.
Col. A. E. S., Maracay; May, 1935.

* **Selenophorus** sp.
Col. A. E. S., Maracay; May, 1935.

Hydrophilidae

Tropisternus collaris Fabr. (Det. L. L. Buchanan)
Col. A. E. S., Maracay; May, 1935.

Lycidae

(Determinations in this family by H. S. Barber.)

Calopteron ? sp.
Col. A. E. S., Valera; May, 1936.

Calopteron sp. near **tropicum** L.
Col. L. F. M., one male and one female collected on weeds. Caripito; August, 1937.

Calopterum tropicum L.
Col. A. E. S., Maracay; May, 1935 and L. F. M., at Caripito, 1937.

Lampyridae

(Determinations in this family by H. S. Barber.)

Aspisoma sp.
Col. L. F. M., Maturín; August, 1937.

* **Aspisoma dilatatum** Cast.
Col. A. E. S., Maracay; May, 1935.

* **Aspisoma ignitum** Linn.
Col. A. E. S., Maracay; May, 1935.

Photinus sp.
Col. A. E. S., Maracay; May, 1935.

Cantharidae

* **Diaphron proteum** Gorh.
Col. A. E. S., Valera; May, 1936.

Meloidae

* **Epicauta grammica** Fisch.
Col. A. E. S., Maracay; May, 1935.

Elateridae

* **Chalcolepidius limbatus** Esch.
Col. A. E. S., Maracay; May, 1935.

Conoderus sp. (Det. W. S. Fisher)
Col. A. E. S., Maracay; May, 1935.

Conoderus sp. near **rodriguezi** Cand. (Det. W. S. Fisher)
Col. L. F. M., Maturín; August, 1937.

Heteroderes laurenti Guer. (Det. W. S. Fisher)
Col. Caripito; August, 1937. Col. L. F. M.

* **Pyrophorus ingnitus** Fabr. (?) (Det. W. S. Fisher)
Col. Maracay; May, 1935. Col. A. E. S.

BUPRESTIDAE

(All determinations in this family by W. S. Fisher.)

Euchroma goliath C. & G.
Col. A. E. S., Valera; May, 1936.

EROTYLIDAE

* **Brachysphaenus** sp.
Col. A. E. S., Maracay; May, 1935.

* **Coccimorphus dichrous** Lec.
Col. A. E. S., Maracay; May, 1935.

* **Cypherotylus debauvei** Demay
Col. A. E. S., Maracay; May, 1935.

COCCINELIDAE

* **Cycloneda sanguinea** Linn.
Col. A. E. S., Valera; May, 1936.

* **Ephilachna borealis** Fabr.
Col. A. E. S., Maracay; May, 1935.

* **Hyperaspis albicolis** Gorh.
Col. A. E. S., Valera; May, 1936.

ALLECULIDAE

Prostenus sp. (Det. E. A. Chapin)
Col. A. E. S., Valera; May, 1936.

Xystropus fulgidus Makl.
Col. A. E. S., Valera; May, 1936.

Xystropus lebasi Makl.
Col. A. E. S., Valera; May, 1936.

TENEBRIONIDAE

Epitragus sp. (Det. E. A. Chapin)
Col. A. E. S., Maracay; May, 1935.

* **Epitragus aurulentus** Kirsh.
Col. A. E. S., Valera; May, 1936.

* **Zophobas morio** Fabr.
Col. A. E. S., Valera, May, 1936.

BOSTRICHIDAE

* **Schistocerus cornutus** Pallas
Col. A. E. S., Valera; May, 1936.

SCARABAEIDAE

(Determinations in this family by E. A. Chapin, except as otherwise noted.)

Ancistrosoma farinosum Salle
Col. A. E. S., Maracay; May, 1935.

Anomala sp.
Col. A. E. S., Maracay; May, 1935.

* **Anomala cincta** Say
Col. A. E. S., Maracay; May, 1935.

* **Anomala cupricollis** Chevr.
Col. A. E. S., Maracay; May, 1935.

Anomala inconstans Burm.
Col. A. E. S., Maracay: May, 1935.

* **Canthidium** sp. (Det. E. A. Chapin)
Col. A. E. S., Maracay; May, 1935.

Ataenius sp.
Col. L. F. M., Caripito; August, 1937.

Ataenius luctuosus Burm. ?
Col. L. F. M., Caripito and Maturín; August, 1937.

Choeridium sp.
Col. A. E. S., Maracay; May, 1935.

Cyclocephala sp..
Col. L. F. M., Caripito, Maturín and Quiriquire; August, 1937. At lights.

Cyclocephala fuliginea Burm.
Col. A. E. S., Valera; May, 1936.

* **Cyclocphala pallens** ?
Col. A. E. S., Maracay; May, 1935.

* **Cyclocephala testacea** Burm.
Col. A. E. S., Maracay; May, 1935.

Euethola bidentatus Burm.
Col. A. E. S., Maracay; May, 1935.

* **Gymnetis dysoni** Schaum.
Col. A. E. S., Maracay; May, 1935.

* **Gymnetis stellata** Latr.
Col. A. E. S., Maracay; May, 1935.

* **Heterogomphus rugicollis** Prell.
Col. A. E. S., Valera; May, 1936.

* **Ligyrus fossor** Latr.
Col. A. E. S., at Valera; May, 1936 and Maracay; May, 1935.

* **Macraspis lucida** Oliv.
Col. A. E. S., Maracay; May, 1935.

* **Onthophagus** sp. (Det. E. A. Chapin)
Col. A. E. S., Maracay; May, 1935.

* **Pelidnota (Pelidnota) lucida** Burm.
Col. A. E. S., Maracay; May, 1935.

Pelidnota prasina Burm.
Col. A. E. S., Maracay; May, 1935.

* **Pinotus** sp.
Col. A. E. S., Valera; May, 1936.

* **Scaptophilus complanatus** Burm.
Col. A. E. S., Maracay; May, 1935.

Trox suberosus Fab.
Col. A. E. S., Valera; May, 1936.

Passalidae

Passalus sp. (Det. E. A. Chapin)
Col. A. E. S., Valera; May, 1936.

* **Passalus interruptus** Linn.
Col. A. E. S., Maracay; May, 1935.

Cerambycidae

Chlorida festiva Linnaeus (Det. L. F. Martorell)
Col. A. E. S., Valera; May, 1936.

* **Cridion cinereum** Oliv.
Col. A. E. S., Maracay; May, 1935.

* **Ibidion** sp.
Col. A. E. S., Maracay; May, 1935.

* **Lagochirus araneiformis** Linn.
Col. A. E. S., Valera; May, 1936.

* **Oxymerus lebasi** Dupont
Col. A. E. S., Valera; May, 1936 and Maracay; May, 1935.

* **Ptychodes trilineatus** Linn.
Col. A. E. S., Maracay; May, 1935.

Spalacopsis sp.
Col. A. E. S., Valera: May, 1936.

Trachyderes succinctus Linn.
Col. L. F. M., Maturín; August, 1937.

Chrysomelidae

(All determinations in this family by H. S. Barber, except as otherwise noted.)

Acanthonycha sp. ?
Col. A. E. S., Valera: May, 1936.

Asphaera sp.
Col. A. E. S., Valera: May, 1936.

* **Chalepus** sp. (Det. L. F. Martorell)
Col. A. E. S., Valera: May, 1936.

* **Chelymorpha** sp.
Col. A. E. S., Maracay; May, 1935.

* **Chelymorpha rufipennis** Boh.
Col. A. E. S., Maracay; May, 1935.

* **Chirida insubida** Boh.
Col. A. E. S., Maracay; May, 1935.

Colaspis sp. ?
Col. A. E. S., Maracay; May, 1935 and L. F. M., Caripito and Maturín; August, 1937.

Colaspis lebasi Lef. ?
Col. A. E. S.. Valera: May, 1936.

Cissites maculata Sweder
Col. A. E. S., Maracay; May, 1935.

Diabrotica sp.
Col. L. F. M., Caripito; August, 1937.

* **Diabrotica** sp. (near **vittata** Auct.)
Col. A. E. S., Maracay; May, 1935 and Valera; May 1936.

* **Diphaulaca aulica** Oliv.
Col. A. E. S., Valera: May, 1936.

* **Disonycha austriaca** Schauf. (Det. L. F. Martorell)
Col. A. E. S., Valera: May, 1936.

* **Disonycha glabrata** Fabr. (Det. L. F. Martorell)
Col. A. E. S., Valera; May, 1936 and Maracay; May, 1935

* **Disonycha** sp. (Det. L. F. Martorell)
Col. A. E. S., Maracay; May, 1935.

Doryphora sp.
Col. A. E. S., Maracay; May, 1935.

* **Eumolpus sophiae** Kolbe ? (Det. L. F. Martorell)
Col. A. E. S., Maracay; 1935 and Valera; May, 1936.

Euryscopa cingulata Latr.
Col. A. E. S., Valera: May, 1936.

Euryscopa sp.
Col. A. E. S., Maracay; May, 1935.

* **Glyptoscelis fascicularis** Baly
Col. A. E. S., Maracay; May, 1935.

Galerucella sp.
Col. L. F. M., Maturín; August, 1937.

* **Homopoeta** sp. (Det. L. F. Martorell)
Col. A. E. S., Maracay; May, 1935.

Ischiopachys proteus Lacord.
Col. A. E. S., Maracay; May, 1935.

Ischiopachys sp.
Col. L. F. M., Caripito; August, 1937.

Lactica hypocrita Har.
Col. A. E. S., Valera: May, 1936.

Megalostomis anacoreta Lacord.
Col. A. E. S., Maracay; May, 1935 and Valera; May, 1936.

Megascelis sp.
Col. A. E. S., Maracay; May, 1935.

* **Metriona 6-punctata** Fabr.
Col. A. E. S., Valera: May, 1936.

Monachulus sp.
Col. L. F. M., Caripito; August, 1937.

Oedionychis sp. (Det. Martorell)
Col. A. E. S., Maracay; May, 1935.

* **Oedionychis decimguttata** (var.) Fabr. (Det. Martorell)
Col. A. E. S., Valera; May, 1936 and Maracay; May, 1935.

Ochthispa loricata Weise
Col. G. N. Wolcott; Macuto, Venezuela; July, 1926. Feeding on sea-grape leaves. (See (26) page 284.)

* **Oxyodera lanuginosa** Boh. (Det. Martorell)
Col. A. E. S., Maracay; May, 1935.

Poecilaspis sp. (Det. Martorell)
Col. A. E. S., Maracay; May, 1935.

Systena sp.
Col. L. F. M., Caripito; August, 1937.

Typophorus humeralis Baly
Col. A. E. S., Valera: May, 1936.

BRENTHIDAE

Brenthus sp. (near **cylindricus** F.) (Det. L. L. Buchanan)
Col. A. E. S., Maracay; May, 1935.

Brenthus sp. (Det. L. L. Buchanan)
Col. A. E. S., Maracay; May, 1935.

Tychaeus myrmecophagus Hbst. (Det. L. L. Buchanan)
Col. L. F. M., Caripito; August, 1937. This insect was found in colonies of 50 or 60 attached to the trunk of dead trees, in the dark crevices, and places where there was a fungus growing.

CURCULIONIDAE

(Determinations in this family by L. L. Buchanan, except as otherwise noted.)

Acallestes talpa Pasc.
Col. A. E. S., Maracay; May, 1935.

* **Brachyomus ? 4-nodosus** Klug. (Det. Martorell)
Col. A. E. S., Maracay; May, 1935.

Cactophagus striatoforatus Gyll.
Col. A. E. S., Maracay; May, 1935.

* **Compsus 18-signatus** Champ.
Col. A. E. S., Maracay; May, 1935.

Cratosomus lafonti Guer.
Col. A. E. S., Maracay; May, 1935.

Cylindrocerus sp.
Col. L. F. M., Caripito; August, 1937.

* **Dynamis borassi** Fabr. (Det. Martorell)
Col. A. E. S., Maracay; May, 1935.

* **Geraeus** sp.
Col. A. E. S., Valera; May, 1936 and L. F. M., Caripito and Maturín; August, 1937.

Litostylus juvencus Oliv.
Col. A. E. S., Valera; May, 1936 and L. F. M., Caripito; August, 1937.

Merothricus sp. ?
Col. A. E. S., Maracay; May, 1935.

Metamasius hemipterus L.
Col. L. F. M., Maturín and Caripito; August, 1937.

* **Neocyphus** sp. (Det. Martorell)
Col. A. E. S., Valera: May, 1936.

* **Sternechus decussatus** Chevr.
Col. A. E. S., Maracay; May, 1935.

Zygops sp.
Col. L. F. M., Caripito; August, 1937.

DIPTERA

STRATIOMYIDAE

Stratiomyia subalba Walk. (Det. C. T. Greene)
Col. L. F. M., Caripito; August, 1937.

ASILIDAE

Erax sp. (Det. C. T. Greene)
Col. L. F. M., Caripito; August, 1937.

Holcocephala sp. (near **oculata)** Det. C. T. Greene.
Col. A. E. S., Valera; May, 1936.

SYRPHIDAE

Eristalis scutellaris Fab.
Col. L. F. M., Maturín and Caripito; August, 1937.

Eristalis testaceicornis Macq.
Col. A. E. S., Valera; May, 1936.

Mesogramma duplicata Wied.
Col. L. F. M., Caripito and Maturín; August, 1937.

Somatia aestiva Fab.
Col. A. E. S., Valera; May, 1936.

TACHINIDAE

(Determinations in the **Tachinidae** and **Sarcophagidae** by D. G. Hall.)

Archytas piliventris Vdw.
Col. L. F. M., Maturín and Caripito; August, 1937.

Archytas sp.
Col. L. F. M., Maturín; August, 1937.

Gonia sp.
Col. L. F. M., Maturín and Caripito; August, 1937.

SARCOPHAGIDAE

Sarcophaga ? morionella Ald.
Col. L. F. M., Caripito; August, 1937.

Sarcophagula occidua (Fabr.)
Col. L. F. M., Caripito and Maturín; August, 1937.

ORTALIDAE

* **Richardia podagrica** Fabr. (Det. C. T. Greene)
Col. A. E. S., Valera; May, 1936.

LEPIDOPTERA

(All determinations, unless otherwise noted, by W. Schaus.)

PIERIDAE

Eurema sp.
Col. A. E. S., Valera; May, 1936.

NYMPHALIDAE

Heliconius melpomene Linn.
Col. A. E. S., Valera and Maracay; May, 1936 and 1935.

NOCTUIDAE

Anomis illita Guen.
Col. A. E. S., Maracay; May, 1935.

Leucania sp. nov.
Col. A. E. S., Maracay; May, 1935.

AMATIDAE

Cyanopepla submacula Walk.
Col. A. E. S., Maracay; May, 1935.

* **Dinia mena** Hübner
Col. A. E. S., Maracay; May, 1935.

MEGALOPYGIDAE

Megalopyge sp. not recognizable
Col. A. E. S., Maracay; May, 1935.

Norape pura Butl.
Col. A. E. S., Maracay; May, 1935.

HYMENOPTERA

ICHNEUMONOIDEA

ICHNEUMONIDAE

Enicospilus flavus (Fabr.) (Det. R. A. Cushman)
Col. L. F. M., Caripito; August, 1937.

FORMICOIDEA

FORMICIDAE

(Determinations in this family by M. R. Smith.)

* **Atta sexdens** ? (Linn.)
Col. L. F. M., Caripito and Quiriquire; August, 1937.
This is the famous "Bachac" or "parasol ant" of Trinidad and the "bachaco" of Venezuela. The ravages of this ant on agricultural crops are enormous. This species is probably present in the whole country of Venezuela.

Camponotus sp.
Col. A. E. S., Valera; May 1936 and L. F. M., Quiriquire and Caripito; August, 1937.

Cephalotes atratus (Linn.)
Col. L. F. M., Caripito; August, 1937.

Cremastogaster sp.
Col. L. F. M., Caripito; August, 1937.

Ectatoma tuberculatum (Oliv.)
Col. L. F. M., Caripito; August, 1937.

Neoponera sp.
Col. A. E. S., Maracay; May, 1935.

Paraponera clavata (Fabr.)
Col. L. F. M., Caripito; August, 1937.

SPHECOIDEA

SPHECIDAE

(Determinations in this family and in the rest of the **Hymenoptera**, by G. A. Sandhouse.)

Ammobia singularis (Smith)
Col. L. F. M., Caripito and Maturín; August, 1937.

Cerceris spp.
Col. L. F. M., Caripito and Maturín; August, 1937.

Larra americana Sauss.
Col. L. F. M., Caripito; August, 1937. This insect is the parasite of the mole cricket, *Scapteriscus didactylus* Latr. Only two males were collected at Caripito.

Oxybelus (Notoglossa) sp.
Col. L. F. M., Caripito; August, 1937.

Sceliphron figulum (Dahlb.)
Col. L. F. M., Caripito; August, 1937.

BEMBICIDAE

Rubrica surinamensis (DeGeer)
Col. L. F. M., Maturín; August, 1937. A fairly common species in Maturín as well as at Caripito. Very abundant on *Borreria verticillata* (L.) Meyer.

VESPOIDEA

SCOLIIDAE

Campsomeris hyalina Lep.
Imported from Venezuela to Central Aguirre, Aguirre, P. R. (See: Insectae Borinquenses, page 564.)

Myzine sp.
Col. L. F. M., Maturín; August, 1937. One male only was collected, and further identification was not possible, because previous studies in this genus are based chiefly on females.

PSAMMOCHARIDAE

Pepsis dimidiata F.
Col. L. F. M., Caripito; August, 1937.

Pepsis equestris Erich.
Col. A. E. S., Valera; May, 1935.

Pepsis sp.
Col. L. F. M., Caripito and Maturín; August, 1937.

Psammochares sp.
Col. L. F. M., Caripito and Maturín; August, 1937.

NOTE: Miss Sandhouse says, "Family identification to species is nearly impossible in the Psammocharidae; any name now in use is subject to revision."

VESPIDAE

Gymnopolybia pallidipes (Oliv.)
Col. A. E. S., Valera; May, 1936.

* **Polistes canadensis** Linn. (Det G. A. Sandhouse)
Col. L. F. M., Maturín; August, 1937.

Polistes subsericeus Sauss.
Col. L. F. M., Caripito; August, 1937.

Polistes versicolor var. **vulgaris** Beq.
Col. L. F. M., Caripito; August, 1937.

* **Parachartergus colobopterus** (Web.)
Col. A. E. S., Valera; May, 1936.

* **Polybia nigra** Sauss.
Col. L. F. M., Caripito and Maturín; August, 1937. A very abundant wasp on *Borreria verticillata* (L) Meyer.

* **Polybia occidentalis** (Oliv.)
Col. L. F. M., Maturín and Caripito; August, 1937.

Polybia occidentalis var. **albopicta** Sm.
Col. A. E. S., Valera; May, 1936.

Protopolybia sedula (Sauss.)
Col. A. E. S., Valera; May, 1936.

Pseudopolybia compressa (Sm.)
Col. A. E. S., Maracay; May, 1935.

EUMENIDAE

Eumenes canaliculata (Oliv.)
Col. L. F. M., Caripito; August, 1937.

Pachodynerus nasidens (Latr.)
Col. L. F. M., Caripito; August, 1937.

APOIDEA

ANDRENIDAE

Augochlora seminigra Ckll.
Col. L. F. M., Caripito and Maturín; August, 1937.

HYLAEIDAE

Hylaeus polybioides (Schrott.) ?
Col. L. F. M., Caripito; August, 1937.

Hylaeus paragueyensis (Schrott.) ?
Col. L. F. M., Caripito; August, 1937.

MELIPONIDAE

Trigona amalthea (Oliv.)
Col. A. E. S., Valera; May, 1936.

Trigona nigra subsp. **parastigma** Ckll.
Col. L. F. M., Caripito; August, 1937.

Trigona ruficrus corvina Ckll.
Col. L. F. M., Caripito and Maturín; August, 1937. Very abundant on *Borreria verticillata* (L) Meyer. Col. G. N. Wolcott, at Macuto, Venezuela; July, 1926. Wolcott writes (in the Bulletin of Entomological Research, Vol. XVII, 1926–27; page 51 and 52) the following: "In Venezuela, considerable numbers of black bees, determined by Mr. S. A. Rohwer as *Trigona ruficrus corvina* Ckll., were noted hovering about the more tender sea-grape leaves. On closer examination, it was found that the were obtaining honey-dew from the nymphs of a most abundant Membracid, which Dr. W. D. Funkouser has determined as *Enchenopa concolor* Fairm." (For more information see reference cited above.)

Trigona testaceicornis Lep.
Col. L. F. M., Caripito; August, 1937.

Trigona trinidadensis Provancher
Col. A. E. S., Valera; May, 1936.

BIBLIOGRAPHY

1. **Aldrich, J. M.**
A Catalogue of North American Diptera. Smisthsonian Misc. Col., Washington, D. C., **46**(1444) : 1–680, 1905.

2. **Barnes, Wm., & McDunnough, J. H.**
Check List of the Lepidoptera of Boreal America. Herald Press, Decatur, Ill., 392 p., 1917.

3. **Blatchley, W. S.**
Orthoptera of North America, with special reference to the Faunas of Indiana and Florida. Nature Pub. Co., Indianapolis, Ind., 784 p., 1920.

4. **Brues, Ch. T. & Melander, A. L.**
Key to the Families of North American Insects. Boston, 140 p., 1915.

5. **Comstock, J. H.**
An Introduction to Entomology. Comstock Pub. Co., Ithaca, N. Y., 1044 p., 1925.

6. **Champion, G. C.**
Rhynchophora, Coleoptera. Biologia Centrali-Americana. **4** (4) :1 :750, 1902–05.

7. **Cresson, E. T.**
Synopsis of the families and genera of the Hymenoptera of America, North of Mexico. Trans. Ent. Soc., Philadelphia, Pa., 350 p., 1887.

8. **Distant, W. L. & Fowler, W. W.**
Rhynchota. Hemiptera-Heteroptera. Biologia Centrali-Americana. 48. **1** :1–462, 1880–1893.

9. ------------ ------------
Rhynchota. Hemiptera-Homoptera. Biología Centrali-Americana. 48. **1** :147, 1881–1905.

10. **Essig, E. O.**
Insects of Western North America. The MacMillan Co., N. Y., 1035 p., 1929.

11. **Fowler, W. W. & Cockerell, T. D. A.**
Rhynchota. Hemiptera-Homoptera. Biologia Centrali-Americana. 49. **2** :1–339, 1894–1909; & **2** :1–33, 1899.

12. **Gray, R. W.**
Climatological data. U.S.D.A. Weather Bureau, San Juan, P. R., **15**(13) :103, 1935.

13. ------------
Climatological data. U.S.D.A. Weather Bureau, San Juan, P. R., **16**(13) :103, 1936.

14. ------------
Climatòlogical data U.S.D.A. Weather Bureau, San Juan, P. R., **17**:(13) :103, 1937.

15. **Hall, D. G.**
New South American Sarcophagidae (Diptera). Jour. Agr. Univ. Puerto Rico, **22**(2) : 171–175, 1938.

16. **Jacoby, M.**
Coleoptera. Biologia Centrali-Americana. 29. **6**(1) :1–625, 1880–1892.

17. ------------
Coleoptera. Biologia Centrali-Americana. 30 Suppl. **6**(1) : 1–372, 1888–1892.

18. **Leng, Ch.**
Catalogue of the Coleoptera of North America, North of Mexico. John D. Sherman Jr., Mt. Vernon, N. Y., 470 p., 1920.

19. **Lutz, A.**
Estudios de Zoología y Parasitología Venezolanas. Río de Janeiro, Brasil, 133 p., 1928.

20. **Martorell, L. F.**
Preliminary Check List of the Venezuelan Coleoptera. (unpublished) 1934.

21. **Nuñez Tovar, M.**
Insectos Venezolanos transmisoras de enfermedades. Maracay, Venezuela., 35 p., 1921.

22. **Otero, J. I. & Toro, R. A.**
Catálogo de los nombres científicos y vulgares de algunas plantas puertorriqueñas. Est. Exp. Insular, Río Piedras, P. R., Bol. **37**, 248 p., 1931.

23. **Pittier, H.**
Manual de las plantas usuales de Venezuela. Litografía del Comercio, Caracas, Venezuela, 458 p., 1926.

24. **Van Duzee, E. P.**
Catalogue of the Hemiptera of America, north of Mexico, excepting the Aphididae, Coccidae and Aleurodidae. Univ. Calif. Pub., Tech Bull. Ent. **2**, 902 p., 1917.

25. **Wolcott, G. N.**
Notes on the insects of the sea grape, *Coccoloba uvifera* (L.) Jacq., in Porto Rico and adjacent countries. Bull. Ent. Res., **17**(1):51–52, 1926.

26. ------------
Insectae Borinquenses. Jour. Agr. Univ. Puerto Rico, **20** (1):1–628 p., 1936.

HOST PLANT INDEX

GENERIC INDEX

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THE NUTRITIVE VALUES OF SOME FORAGE CROPS OF PUERTO RICO[1]

III. Grasses, Legumes and Mixtures

by Joseph H. Axtmayer, G. Rivera Hernández and D. H. Cook with the technical assistance of José A. Goyco, M. C. de Fernández, J. P. Rodríguez and F. Méndez,

from the Department of Chemistry of the School of Tropical Medicine, San Juan, Puerto Rico and the Department of Chemistry and Agronomy of the Agricultural Experiment Station, Río Piedras, Puerto Rico.

This paper is a report of data collected during the performance of seventeen digestion trials with native sheep, as a continuation of the studies of the nutritive values of forage crops begun three years ago.

Our previous publications give the details of the experimental procedures followed, and may be referred to.

MATERIALS

The forage crops studies and the trials conducted with each were as follows: Three trials with cow peas of which the first was conducted when the plant was beginning to bloom, the second during the full bloom stage, and the third during the full pod stage; three trials with Merker grass collected just after the blooming stage; one with "Yaraguá" grass during the blooming stage; two with Para grass just after the blooming stage; three with alfalfa hay which was not completely dried; one with a mixture consisting of 2/3 Merker grass and 1/3 pigeon pea in the full bloom stage; one with another mixture consisting of 2/3 Para grass and 1/3 pigeon pea in the full bloom stage; and three trials with a low nitrogen synthetic ration used for the purpose of determining the protein maintenance requirements of all the sheep used in the above trials.

1 Cooperative project between the Agricultural Experiment Station of the University of Puerto Rico and the School of Tropical Medicine.

Data and Discussion

The schedule followed during the course of the studies is given in Table 1.

Table 2 gives the weights of the wet and dry feed consumed or refused and the feces eliminated, the volumes of water the sheep drank and that of the urine voided during each of the ten-day trials. Except in the trial with the alfalfa hay, it will be noticed that the water intake is low compared with the urine voided. This is accounted for by the fact that the crops, as brought from the field, were wet with either rain or dew, while the alfalfa had been partially dried and stored.

Tables 3 and 4 contain data collected during the low protein trials performed to determine the protein maintenance requirements of our sheep. Various synthetic rations were tried, some of which were entirely refused or eaten sparingly by the animals. The final rations used, from which the data herein reported were collected, had the following compositions.

Rations	Trial 15	Trials 16 and 17
Merker grass straw[1]	20 %	50%
Sucrose, brown	21 4%	15%
Corn starch	21 4%	25%
Steamed bone meal	2 0%	5%
Corn oil	1 3%	3%
Cellu flour	33 9%	—
Sodium chloride	—	2%

The elimination of the Cellu flour, the decrease in the percentage of sucrose and the addition of salt seemed to produce a more appetizing ration. The values obtained for the fecal nitrogen per gram of dry matter ingested and the urinary nitrogen per kilogram of body weight compare favorably with the previously obtained values.

The percentages by weight, determined on the dry basis, of the nitrogen in the feeds fed, feeds refused, and feces and urine eliminated (the values for the latter being expressed in percentages by volume), are given in Table 8, while Table 9 contains the chemical analyses of the feces as determined on the dry basis.

1 Prepared in the laboratory by removing all the leaves from the air dried grass, cleaning the stems and then grinding them.

A summary of the data collected during the digestion trials upon which the calculations of the biological values of the proteins of the grasses and legumes studied is given in Table 10. The biological value of the protein of the cow pea increases as the plant changes from the just before blooming stage through the full bloom to the full pod stages. The Para grass protein gave a higher biological value than the Merker grass protein, both having been harvested during the same stage of maturity. In the cases of the mixtures, the Para grass —pigeon pea mixture gave a higher biological value for protein than the Merker grass— pigeon pea mixture.

Table 11 contains data relative to the digestible nutrients per 100 pounds of legumes and grasses as harvested for our trials. Among the legumes, we find that the alfalfa hay yields the highest total digestible nutrients together with a narrow nutritive ratio. Among the grasses, Yaraguá grass has the highest total digestible nutrients, but a very wide nutritive ratio.

The digestible nutrients produced per cuerda[1] of the grasses and legumes are found in Table 12, while Table 13 gives us the yields of calcium and phosphorus per cuerda and per ton of green legumes and grasses.

The net protein values of the legumes and grasses studied, fed singly or in mixtures, are given in Table 14. These values are of importance in calculating the weight of any feed necessary to maintain an animal in nitrogen equilibrium or to supply the requirements for milk production or growth. The grasses may be arranged in the following order of decreasing efficiency as regards their net-protein values if we collect all the data made available in this and previous studies: 1. Guinea grass, 0.80; 2. Merker grass, 0.78; 3. Para grass, 0.70; 4. Elephant grass, 0.64; 5. Guatemala grass, 0.64; and Yaraguá grass, 0.34.

The data of the nitrogen balance in grams as the percentage of the total intake are used to calculate the total nitrogen stored by the animals, and are contained in Table 15.

A summary of the indexes determined during the trials is given in Table 16.

The vitamin A activities of the grasses studied were also determined. The results given in Table 17 were obtained during the last two years.

1 One "cuerda" = 0.9712 acre.

SUMMARY AND CONCLUSIONS

The data for a total of seventeen digestion trials with sheep receiving grasses, legumes, two mixtures of these, and low protein synthetic mixtures as sole rations are reported.

The biological values for the proteins of the cow pea increase as the plant passes from the just before blooming stage through the full bloom to the full pod stages of maturities. The biological values for proteins are also higher for the grasses than for the legumes when fed singly.

The grasses studied during the last three years can be arranged in the following order of decreasing net-protein values: Guinea, Merker, Para, Elephant, Guatemala and Yaraguá.

The nutritive ratio for the Yaraguá grass is very wide due to the low digestible protein, as is shown in the data.

Alfalfa hay yields more total digestible nutrients, more crude fiber and more ether soluble extract than any of the other legumes studied.

The percentage intake of protein stored is greater with a mixture of Merker grass and pigeon pea than when the grass is fed alone.

The vitamin A activities of some grasses and legumes are reported.

LITERATURE CITED

1. Axtmayer, Joseph H., Conrado F. Asenjo, Jr., and D. H. Cook: Jour. Agric. Univ. P. R. 22 (2); 95-122, 1938.

2. Axtmayer, Joseph H., G. Rivera Hernández, and D. H. Cook: Ditto. 22 (4); 455-481, 1938.

TABLE 1

SCHEDULE FOLLOWED STARTING SEPTEMBER 19, 1938 TO JUNE 28, 1939

Trial No.	Ration	Preliminary period Starts		Preliminary period Ends		Experimental period Starts		Experimental period Ends		Animal No.
1	Cow pea (starting blooming)	Sept.	19	Oct.	1	Oct.	1	Oct.	11	1—2— 3— 4— 5— 6
2	Cow pea (full blooming stage)	Oct.	2	Oct.	12	Oct.	12	Oct.	22	7—8— 9—10—11—12
3	Cow pea (in pads)	Oct.	11	Oct.	22	Oct.	23	Nov.	2	1—2— 3— 4— 5— 6
4	Merker grass (after blooming)	Nov.	1	Nov.	11	Nov.	11	Nov.	21	7—8— 9—10—11—12
5	Merker grass (after blooming)	Nov.	11	Nov.	21	Nov.	22	Dec.	2	1—2— 3— 5— 6
6	Yaraguá grass (full bloom, N only)	Dec.	6	Dec.	16	Dec.	16	Dec.	26	7—8— 9—10—11—12
7	Alfalfa hay	Dec.	16	Dec.	26	Dec.	27	Jan.	6	1—2— 3— 4— 5— 6
8	Alfalfa hay	Dec.	27	Jan.	6	Jan.	7	Jan.	17	7—8— 9—10—11—12
9	Alfalfa hay	Jan.	7	Jan.	17	Jan.	18	Jan.	28	1—2— 3— 4— 5— 6
10	Merker grass (after blooming)	Jan.	17	Jan.	28	Jan.	29	Feb.	8	7—8— 9—10—13—14
11	2/3 Merker grass+1/3 pigeon pea (in flower)	Jan.	29	Feb.	8	Feb.	9	Feb.	19	1—2— 3— 4— 5— 6
12	2/3 Malojillo grass + 1/3 pigeon pea (in flower)	Feb.	9	Feb.	19	Feb.	20	March	2	7—8— 9—10—13—14
13	Para grass (after blooming stage)	Feb.	29	March	2	March	3	March	13	1—2— 3— 4— 5— 6
14	Para grass (after blooming stage)	March	2	March	13	March	14	March	24	7—8— 9—10—13—14
15	Low protein diet + 20% Merker grass straw	May	6	May	16	May	16	May	24	7—8—13—14
16	Low protein diet + 50% Merker grass straw	May	26	June	7	June	8	June	18	1—3— 4— 5— 6
17	Low protein diet + 50% Merker grass straw	June	8	June	18	June	18	June	28	7—9—10—14

TABLE 2.

SUMMARY OF THE WET AND DRY FEED AND FECES CONSUMED AND ELIMINATED, RESPECTIVELY, AND OF THE WATER INTAKE AND URINE ELIMINATION IN TEN-DAY METABOLISM EXPERIMENTS

Trial No.	Animal No.	Ration	Wet feed consumed	Feed on dry basis fed	Feed on dry basis refused	Feed on dry basis consumed	Wet feces	Dry feces	Water	Urine
			Grams	Grams	Grams	Grams	Grams	Grams	cc.	cc.
1	1	Cow pea (starting blooming)	50236	7933	2530	5403	4722	2048	120	29250
	2	do.	54432	8727	2909	5818	4832	2405	320	31660
	3	do.	60896	10578	3639	6939	6035	2724	280	36860
	4	do.	48989	7933	2616	5317	4016	2091	370	28570
	5	do.	55453	10314	4458	5856	5006	2358	460	33060
	6	do.	62370	9520	2834	6686	5515	2377	170	37080
2	7	Cow pea (full-blooming stage)	54772	10459	4526	5933	5686	2286	170	32530
	8	do.	60102	10680	3757	6923	7133	2634	120	33710
	9	do.	68493	10902	3007	7895	8076	2938	400	41190
	10	do.	66793	10791	3052	7739	7327	2830	160	39330
	11	do.	56247	10570	4182	6388	5218	2710	190	33850
	12	do.	72916	11787	3652	8135	7611	3114	280	44020
3	1	Cow pea (in full pods)	50236	14660	6858	7802	5574	2668	205	23295
	2	do.	46267	14660	7619	7041	4516	2318	285	20200
	3	do.	50123	14660	6719	7941	5388	2548	955	23610
	4	do.	46494	14660	7682	6978	4292	2322	1120	21970
	5	do.	49102	14660	7146	7514	5758	2576	1280	24375
	6	do.	58514	14660	5752	8908	6548	3140	235	27440
4	7	Merker grass (after blooming)	26309	16323	10867	5456	5231	2332	455	8085
	8	do.	28376	16323	11209	5114	4833	2150	1245	9260
	9	do.	31298	16323	10137	6186	5905	2814	550	10230
	10	do.	34247	16323	9378	6945	5795	2890	785	10770
	11	do.	29371	16323	10692	5631	4529	2426	1680	10350
	12	do.	31752	16323	10074	6249	5176	2744	2740	13460
5	1	Merker grass (after blooming)	33793	15377	8932	6445	6446	3086	1080	11455
	2	do.	29030	15377	9939	5438	4719	2488	335	9125
	3	do.	32659	15377	9480	5897	6613	2842	2380	11975
	5	do.	29938	15377	9836	5541	6212	2656	885	10150
	6	do.	35154	15377	8692	6685	6824	3194	210	12210
6	7	Yaraguá grass (N only; full bloom)	16217	11607	7912	3695	3985	2119	1850	6160
	8	do.	17918	11607	7208	4399	3987	2151	585	5800
	9	do.	19268	11607	6719	4888	4087	2353	350	5990
	10	do.	19619	11607	6627	4980	4025	2472	500	6300
	11	do.	20515	11750	6345	5405	4800	2811	280	6450
	12	do.	20639	11750	6351	5399	4489	2682	170	6095
7	1	Alfalfa hay	8051	15332	8444	6888	5139	3004	19070	8170
	2	do.	8392	15332	8177	7155	4774	2946	16910	7410
	3	do.	8505	15332	8068	7264	5637	3088	18660	9260
	4	do.	8165	15332	8351	6981	4788	2939	15650	7870
	5	do.	8959	15332	7638	7694	6776	3316	17230	7430
	6	do.	10433	18398	9483	8915	6565	3898	18730	7660
8	7	Alfalfa hay	7825	15522	8482	7040	5978	3020	21770	8090
	8	do.	9412	15522	7276	8246	9839	3444	24710	8895
	9	do.	9639	18627	10108	8519	8038	3868	25060	9950
	10	do.	10546	18627	9097	9530	9187	3941	30375	10450
	11	do.	11794	18627	8272	10355	9331	4364	24808	10020
	12	do.	11227	18627	8632	9995	8627	4238	27900	11230
9	1	Alfalfa hay	9866	19364	10610	8754	7680	3810	27200	11920
	2	do.	9299	19364	11233	8131	6631	3436	20600	8510
	3	do.	9866	19364	10741	8623	9131	3337	25790	10130
	4	do.	8959	19364	11425	7939	6739	3517	21560	10120
	5	do.	10093	19364	10544	8820	9709	3917	23140	8350
	6	do.	12474	19364	8455	10909	8800	4474	27130	9910
10	7	Merker grass (after blooming)	32773	11529	5021	6508	5245	2780	110	14465
	8	do.	34474	11529	4642	6887	7702	2932	60	13140
	9	do.	41391	13834	5527	8307	6975	3517	180	17770
	10	do.	41617	13834	5615	8219	6435	3529	200	18660
	13	do.	34814	11529	4577	6952	5392	2764	640	16410
	14	do.	34247	11529	4604	6925	8052	3137	3960	18200
11	1	2/3 Merker grass (blooming) + 1/ pigeon pea (in flower)	34814	11888	5058	6830	6257	3303	605	18440
	2		32432	11888	5639	6249	5446	3007	185	11360
	3	do.	35948	11888	4700	7188	9119	3289	3020	13810
	4	do.	32319	11888	5371	6517	5336	3024	700	12600
	5	do.	34814	11888	5075	6813	10751	3366	8040	9800
	6	do.	44453	13968	4939	9029	9031	4082	250	17960
12	7	2/3 Para grass + 1/3 pigeon pea (in flower)	35608	11654	4552	7102	8021	3333	405	14820
	8		31525	11654	5537	6117	8646	2978	540	11930
	9	do.	43432	14276	5719	8557	11554	4167	170	17200
	10	do.	42071	14567	6300	8267	10480	3928	320	16740
	13	do.	38896	14567	6936	7631	12213	3752	200	12810
	14	do.	39463	14567	6710	7857	12144	3904	830	14440
13	1	Para grass (after blooming stage)	31865	11218	4956	6262	7059	2771	260	11260
	2	do.	31752	11218	4981	6237	6499	2732	120	11840
	3	do.	36855	13182	5911	7271	12651	3043	2140	10610
	4	do.	35494	14023	7059	6964	6882	2749	240	12760
	5	do.	37309	14023	6632	7391	11354	3139	380	11090
	6	do.	40144	14023	6277	7746	9446	3370	160	14440
14	7	Para grass (after blooming stage)	35834	12136	6133	6003	5304	2634	260	17530
	8	do.	33907	10113	4306	5807	8201	2734	470	14620
	9	do.	45020	12389	4626	7763	9641	3739	210	21000
	10	do.	49989	13737	5144	8593	9464	3848	220	23140
	13	do.	42298	12389	4862	7527	9249	3430	820	19200
	14	do.	44793	12389	4379	8010	10725	3511	1230	19250

TABLE 3.

LOW-PROTEIN DIET EXPERIMENT

SUMMARY OF DATA

TEN-DAY PERIOD

Trial No.	Animal No.	Ration	Wet feed consumed	Dry feed consumed	Wet feces	Dry feces	Water	Urine
			Grams	Grams	Grams	Grams	cc.	cc.
15*	7	Low protein diet + 20% Merker grass straw	3518	3236	2627	1613	6150	3198
	8		2068	1902	1666	1021	4080	1213
	13		1974	1814	1506	948	5900	2030
	14		2890	2658	1782	1267	5960	2230
16	1	Low protein diet + 50% Merker grass straw	3756	3465	2950	1809	8220	4615
	3		3391	3128	2957	1322	10290	4985
	4		3018	2784	1669	1208	6910	3965
	5		2812	2594	2769	1121	7440	2215
	6		3090	2851	2939	1261	6180	2448
17	7	Low protein diet + 50% Merker grass straw	3010	2736	2515	1536	8530	4773
	9		3782	3437	3317	1746	8950	3992
	10		3948	3588	2817	1854	9060	3915
	14		3171	2882	2527	1598	8480	5127

* Eight-day experiment.

TABLE 4.

MAINTENANCE REQUIREMENT OF LAMBS AVERAGING 18.67 KGS. IN WEIGHT, BODY NITROGEN IN FECES PER GRAM OF DRY MATTER INGESTED AND BODY NITROGEN IN URINE PER KG. OF BODY WEIGHT, BASED ON TEN-DAY TRIALS DURING WHICH NEARLY NITROGEN-FREE RATIONS WERE FED

Trial No.	Animal No.	Average weight	Dry matter ingested	Nitrogen in feed consumed	Total fecal nitrogen	Total urinary nitrogen	Total urinary and fecal nitrogen	Fecal nitrogen per gm. of dry matter ingested	Urinary nitrogen per kg. body weight
		Kg.	Grams	Percent	Grams	Grams	Grams	Grams	Grams
15	7	17.46	3236	0.130	10.39	7.84	18.23	0.00321	0.449
	8	14.27	1902	0.130	7.33	7.35	14.68	0.00386	0.515
	13	17.18	1814	0.130	7.84	14.11	21.95	0.00431	0.821
	14	18.67	2658	0.130	10.67	11.77	22.44	0.00401	0.630
16	1	18.01	3465	0.081	14.00	7.57	21.57	0.00404	0.420
	3	17.27	3128	0.081	12.66	8.82	21.48	0.00405	0.511
	4	19.65	2784	0.081	10.06	14.99	25.05	0.00361	0.763
	5	19.86	2594	0.081	10.87	9.68	20.55	0.00419	0.487
	6	21.19	2851	0.081	13.62	7.71	21.33	0.00476	0.364
17	7	14.91	2736	0.126	11.01	7.30	18.31	0.00402	0.490
	9	21.94	3437	0.126	19.38	13.81	33.19	0.00564	0.629
	10	23.64	3588	0.126	15.98	10.96	26.94	0.00445	0.463
Averages of 12 animals		Values used in the calculation of the data.						0.00418	0.545

TABLE 5

FEED

ANALYSES OF GRASSES AND LEGUMES

Wet Basis

Trial No.	Item	Total moisture	Crude protein (N x 6.25)	Ether-soluble extract	Crude fiber	Carbo-hydrate	Ash	Calcium	Phosphorus	Ca./P ratio
		Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	
1	Cow pea (starting blooming)	88.34	2.09	0.54	3.09	4.13	1.81	0.236	0.0247	9.53
2	Cow pea (full blooming stage)	87.80	2.45	0.62	2.97	4.30	1.86	0.362	0.0257	10.62
3	Cow pea (in full pods)	83.84	2.25	0.54	4.97	6.39	2.01	0.174	0.0722	3.20
4	Merker grass (after blooming)	76.01	2.07	0.75	8.66	10.06	2.45	0 0825	0.0461	1.79
5	do.	76.62	2.49	0.68	7.52	9.75	2.94	0.0905	0.0423	2.10
6	Yaraguá grass (N only)	68.41	0.99	0.78	12.14	15.22	2.46	0.108	0 0417	2.59
7	Alfalfa hay	15.50	15.11	2.05	29.61	28.12	9.61	0.980	0.192	5.11
8	do.	14.45	15.72	1.90	31.75	26.79	9.39	0.975	0.178	5.48
9	do.	14.62	14.25	1.71	32.02	28.80	8.60	1.03	0.180	5.73
10	Merker grass (after blooming)	78.82	1.95	0.64	7.48	8.83	2.28	0.0591	0.0428	1.38
11	2/3 Merker grass (blooming) + 1/3 pigeon peas (in flower)	78.16	2.99	0.90	7.10	8.88	1.97	0.115	0.0542	2.12
12	2/3 Para grass + 1/3 pigeon peas (in flower)	78.59	2.56	0.62	6.77	9.51	1.95	0.115	0.0617	1.87
13	Para grass (after blooming stage)	79.39	1.70	0.51	6.74	9.73	1.93	0.0511	0.0437	1.17
14	do.	81.42	2.07	0.48	4.93	8.44	2.66	0.0632	0.0407	1.55

TABLE 6

FEED

ANALYSES OF GRASSES AND LEGUMES

Dry Basis

Trial No.	Item	Total solids	Crude protein (N x 6.25)	Ether-soluble extract	Crude fiber	Carbo-hydrate	Ash	Calcium	Phosphorus	Ca./P ratio
		Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	
1	Cow pea (starting blooming)	11.66	17.94	4.59	26.51	35.46	15.50	2.02	0.212	9.53
2	Cow pea (full blooming stage)	12.20	20.06	5.07	24.36	35.25	15.26	2.24	0.211	10.62
3	Cow pea (in full pods)	16.16	13.95	3.37	30.77	39.50	12.41	1.43	0.447	3.20
4	Merker grass (after blooming)	23.99	8.63	3.12	36.10	41.92	10.23	0.344	0.192	1.79
5	do.	23.38	10.63	2.92	32.16	41.72	12.57	0.380	0.181	2.10
6	Yaraguá grass (N only)	31.59	3.13	2.48	38.43	48.18	7.78	0.342	0.132	2.59
7	Alfalfa hay	84.50	17.88	2.43	35.04	33.28	11.37	1.16	0.227	5.11
8	do.	85.55	18.38	2.22	37.11	31.31	10.98	1 14	0 208	5.48
9	do.	85.38	16.69	2.00	37.50	33.74	10.07	1.21	0.211	5.73
10	Merker grass (after blooming)	21.18	9.19	3.04	35.31	41.69	10.77	0.279	0.202	1.38
11	2/3 Merker grass (blooming) + 1/3 pigeon peas (in flower)	21.84	13.69	4.13	32.52	40.66	9.00	0.525	0.248	2.12
12	2/3 Para grass + 1/3 pigeon peas (in flower)	21.41	11.94	2.91	31.60	44.46	9.09	0.538	0.288	1.87
13	Para grass (after blooming stage)	20.61	8.25	2.47	32.69	47.21	9.38	0.248	0.212	1.17
14	do.	18.58	11.13	2.57	26.55	45.45	14.30	0.340	0.219	1.55

TABLE 7

REFUSE

ANALYSES OF THE REFUSED GRASSES AND LEGUMES

Dry Basis

Trial No.	Item	Total solids	Crude protein (N x 6.25)	Ether-soluble extract	Crude fiber	Carbo-hydrate	Ash	Calcium	Phophorus
		Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
1	Cow pea (starting blooming)	13.77	13.56	2.36	37.36	31.64	15.08	1.40	0.155
2	Cow pea (full-blooming stage)	14.33	13.69	2.61	37.57	33.73	12.40	1.59	0.164
3	Cow pea (in full pods)	17.22	10.44	1.64	43.54	34.20	10.18	1.07	0.142
4	Merker grass (after blooming)	27.51	6.44	2.16	40.19	42.46	8.75	0.258	0.171
5	do.	27.89	8.06	2.12	37.27	41.54	11.01	0.336	0.163
6	Yaraguá grass (N only)	38.40	2.42	2.11	42.93	45.60	6.94	0.278	0.119
7	Alfalfa hay	83.61	15.13	1.67	39.68	32.65	10.87	1.01	0.227
8	do.	82.43	14.06	1.57	44.49	29.23	10.55	0.981	0.215
9	do.	83.41	12.13	1.52	46.27	31.64	8.44	0.987	0.189
10	Merker grass (after blooming)	23.23	5.19	1.68	42.30	43.15	7.68	0.144	0.175
11	2/3 Merker grass + 1/3 pigeon peas (in flower)	25.39	7.38	2.10	50.32	33.75	6.45	0.377	0.147
12	2/3 Para grass + 1/3 pigeon peas (in flower)	24.08	6.63	1.99	38.70	44.65	8.03	0.354	0.245
13	Para grass (after blooming stage)	21.92	6.50	2.19	34.98	47.35	8.98	0 189	0.173
14	do.	20.76	7.50	1.75	31.49	45.08	14.18	0.278	0.183

TABLE 8

PER CENT NITROGEN IN FEED FED, REFUSE LEFT AND FECES ON DRY BASIS

(Urine Analyses, Percent by Volume).

Trial No.	Animal No.	Ration	Nitrogen in feed fed	Nitrogen in refuse left	Nitrogen in feces	Nitrogen in urine
			Percent	Percent	Percent	Percent
1	1 2 3 4 5 6	Cow pea (starting blooming)	2.87	2 17	1.89 1 92 1.97 1.72 1.86 1.95	0.393 0.400 0.416 0.393 0.457 0.345
2	7 8 9 10 11 12	Cow pea (full-blooming stage)	3.21	2.19	1.91 2.25 2.10 2.10 2.15 2.03	0.414 0.448 0.413 0.405 0.510 0.383
3	1 2 3 4 5 6	Cow pea (in full pods)	2 23	1.67	1.97 1.89 2.01 1.96 2.02 2.05	0.472 0.537 0.487 0.509 0.478 0.434
4	7 8 9 10 11 12	Merker grass (after blooming)	1.38	1.03	1.65 1.83 1.64 1.63 1.76 1.71	0.675 0.622 0.672 0.629 0.693 0.515
5	1 2 3 5 6	Merker grass (after blooming)	1.70	1.29	1.59 1.56 1.70 1.63 1.63	0.706 0.730 0.619 0.689 0.669
6	7 8 9 10 11 12	Yaraguá grass (full bloom; N only)	0 500	0.387	1.05 1.21 1.04 1.09 1.00 1.05	0.217 0.230 0.260 0.264 0.262 0.277
7	1 2 3 4 5 6	Alfalfa hay	2.86	2.42	2.56 2.53 2.57 2.45 2.38 2.38	1.98 2.00 1.76 1.94 1.91 2.09
8	7 8 9 10 11 12	Alfalfa hay	2.94	2.25	2.59 2.69 2.04 2.66 2.57 2.56	1.72 1.66 1.82 1.83 1.95 1.62
9	1 2 3 4 5 6	Alfalfa hay	2.67	1.94	2.50 2.55 2.66 2.46 2 33 2.50	1.50 1.90 1.63 1.76 1 84 2.01
10	7 8 9 10 13 14	Merker grass (after blooming)	1.47	0 83	1.46 1.53 1 39 1.49 1.54 1.52	0.47 0.53 0.41 0.48 0.44 0.40
11	1 2 3 4 5 6	2/3 Merker grass + 1/3 pigeon peas (in flower)	2 19	1 18	2 12 2 17 2 41 2 14 2 24 2.23	0 76 0.77 0.71 0.84 1.00 0.66
12	7 8 9 10 13 14	2/3 Para grass + 1/3 pigeon peas (in flower)	1.91	1.06	1.87 2 27 1 94 2.01 2.02 1 95	0.47 0.67 0 57 0.59 0 79 0.67
13	1 2 3 4 5 6	Para grass, after blooming stage	1.32	1 04	1.44 1.35 1.58 1.41 1.41 1 42	0.50 0.43 0.54 0.46 0.56 0.42
14	7 8 9 10 13 14	Para grass, after blooming stage	1 78	1 20	1 48 1 68 1 45 1 49 1 54 1.52	0 387 0 466 0 367 0 395 0 419 0.420
15	7 8 13 14	Low-protein diet with 20% Merker grass straw	0.130		0.644 0.718 0.827 0.842	0.245 0.606 0.695 0.528
16	1 3 4 5 6	Low-protein diet with 50% Merker grass straw	0.081		0.774 0.958 0.833 0.970 1.08	0.164 0.177 0.378 0.437 0.315
17	7 9 10 14	Low-protein diet with 50% Merker grass straw	0.126		0.717 1.11 0.862 1.47	0.153 0.346 0.280 0.266

TABLE 9

PROXIMATE ANALYSES OF FECES

Dry Basis

Trial No.	Ration	Animal No.	Total solids	Crude protein (N x 6.25)	Ether-soluble extract	Crude fiber	Carbo-hydrates	Ash	Calcium	Phospho-rus
			Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
1	Cow pea (starting blooming)	1	43.79	11.81	5.04	24.72	22.90	35 53	5.15	0.558
		2	50.61	12 00	5.79	23.32	22.41	-- --	5.39	0.565
		3	45.65	12.31	6.40	21.35	23.05	36.89	5.16	0.565
		4	52.66	10 75	4.70	24.70	26.72	33.13	5.34	0.580
		5	47.90	11 63	5.62	22.46	25.34	34.95	5.32	0.626
		6	43.64	12.19	5.85	22.13	25.68	34.15	5.40	0.488
2	Cow pea (full-blooming stage)	7	40.70	11.94	4.57	21.95	26.20	35.34	5.62	0.530
		8	37.08	14.06	6.92	16.94	26.72	35.36	5.18	0.512
		9	36.64	13.13	5.12	22.68	23.32	35.75	5.58	0.479
		10	38.99	13.13	5.36	21.66	22.15	37.70	5.69	0.568
		11	52.64	13 44	5.77	19.81	23.34	37.64	5.88	0.780
		12	40.96	12.69	5.79	21.73	22.73	37.06	5.42	0.567
3	Cow pea (in full pods)	1	48.22	12.31	6.11	28.95	26.63	26.00	3.83	0.551
		2	51.46	11.81	5.75	30.77	27.28	24.39	3.53	0.610
		3	47.98	12.56	6.28	28.69	25.36	27.11	3.93	0.536
		4	54.48	12.25	6.09	32.49	24.02	25.15	3.53	0.576
		5	45.87	12.63	6.20	31.87	24.45	24.85	3.55	0.584
		6	48.40	12.81	5.35	31.44	25.75	24.65	3.35	0.491
4	Merker grass (after blooming)	7	45.55	10.31	5.10	24.27	40.54	19.78	0.645	0.487
		8	47.01	11.44	5.12	23.19	40.67	19.58	1.12	0.560
		9	48.92	10.25	5.29	26.45	41.30	16.71	1.01	0.578
		10	50.70	10.19	4.84	25.92	40.46	18.59	1.21	0.554
		11	55.42	11.00	5.05	24.28	40.08	19.59	1.15	0.609
		12	56.72	10.69	4.89	23.64	40.75	20.03	1.31	0.661
5	Merker grass (after blooming)	1	48.03	9.94	3.22	22.49	38.94	25.41	1.54	0.496
		2	53.26	9.75	2.99	22.76	38.66	25.84	1.47	0.561
		3	43.87	10.63	3.17	22.19	38.95	25.06	1.44	0.489
		5	42.88	10.19	5.22	22.39	36.56	25.64	1.46	0.474
		6	46.98	10.19	4.40	24.44	37.32	23.65	1.36	0.471
6	Yaraguá grass (in full bloom)	7	53.43	6.56	3.85	27.73	45.99	15.87	0.949	0.338
		8	53.97	7.56	4.08	25.34	46.56	16.46	1.16	0.472
		9	57.73	6.50	3.61	27.51	47.62	14.76	0.962	0.427
		10	62.03	6.81	3.72	28 82	46.15	14.50	1.04	0.434
		11	58.65	6.25	3 45	28 63	47.28	14.39	0.983	0.369
		12	59.79	6.56	3.61	28.32	46.61	14.90	1.04	0.367
7	Alfalfa hay	1	58 36	16.00	6.45	29.40	31.71	16.44	3.27	0.602
		2	62.66	15 81	4.66	30.78	32.60	16.15	3.03	0.589
		3	55.39	16.06	6 04	30 51	30.76	16.63	3.12	0.542
		4	61.78	15 31	4 91	31.97	31.50	16.31	3.15	0.556
		5	49.16	14.88	5 15	34.32	30.66	14.99	2.75	0.553
		6	59.59	14.88	4.58	35.18	31.21	14.15	2.70	0.555
8	Alfalfa hay	7	51.47	16.19	4 19	30 29	33.03	16.30	2.98	0.427
		8	34.96	16.81	4.49	29.21	32.29	17.20	2.98	0.554
		9	48.43	12.75	4.95	28.90	38.10	15.30	2.83	0.450
		10	44.48	16 63	5.40	29.15	32.30	16.52	3.02	0.492
		11	46.82	16 06	4.71	30 91	32.17	16.15	3.16	0.581
		12	49.83	16.00	4.41	30.19	32.47	16.93	3.01	0.533
9	Alfalfa hay	1	49.62	15 63	4 66	33 51	33.17	13.03	3.13	0.569
		2	52.04	15 94	5 44	32 41	32.42	13.79	3.20	0.517
		3	38.31	16 63	6 24	32 31	30.09	14.73	3.23	0.488
		4	52.29	15 38	5 30	34 08	32.01	13.23	3.01	0.488
		5	40 62	14 56	4.82	35.46	32 82	12.34	2.66	0.421
		6	51 05	15 63	5.05	34 04	32.61	12.67	2.88	0.312
10	Merker grass (after blooming)	7	53.51	9 13	4 38	25.15	40 03	21.31	0.842	0.430
		8	38 65	9 56	4 16	25 44	38 32	22.52	0.910	0.439
		9	51 51	8 69	3 67	26 37	40 07	21.20	0.710	0.343
		10	55 41	9 31	3 62	26 94	38 40	21 73	0.845	0.424
		13	51 47	9 63	3 59	24 94	38 83	23 01	0 890	0.426
		14	39 94	9 50	3 90	25 92	38 51	22 17	0 869	0.421
11	2/3 Merker grass + 1/3 pigeon peas (in flower)	1	53 15	13 25	3 66	32 33	34 90	15.86	1.36	0.485
		2	44.61	13.56	3.74	31.30	35 56	15.84	1.34	0.472
		3	37.41	15 06	3.98	31.02	33.57	16.37	1.35	0.485
		4	57.17	13 38	4.50	30.46	35.50	16.16	1.38	0.452
		5	31 58	14.00	3.71	30.30	34.89	17.10	1.16	0.457
		6	46.20	13.94	4 09	31.13	34.57	16.27	1.20	0.439
12	2/3 Para grass + 1/3 pigeon peas (in flower)	7	41 66	11.69	3.81	31.31	38.49	14.70	1.05	0.435
		8	34 74	14 19	4.20	30.91	35.29	15.41	1.21	0.445
		9	36 51	12.13	3.52	31.55	38 22	14.58	0.965	0.401
		10	38.14	12 56	3 39	32.37	37.10	14.58	1.04	0.429
		13	31 69	12 63	4.26	30 42	36.12	16.57	1.15	0.467
		14	32.47	12 19	4.05	32 51	35.53	15.72	1.14	0.492
13	Para grass, after-blooming stage	1	40 12	9 00	3.28	30.45	42 91	14.36	0.752	0.412
		2	42.84	8 44	2 58	29.91	45 61	13.46	0.682	0.380
		3	24.14	9 88	2 77	28 53	42.90	15.92	0.790	0.401
		4	38 67	8.81	2 94	28 30	45.24	14.71	0.774	0.435
		5	28.25	8 81	3.08	28 94	44 51	14.66	0.668	0.403
		6	36 20	9 00	2 99	30 06	44 47	13.48	0.655	0.453
14	Para grass, after-blooming stage	7	51.50	9 25	3.25	24.67	40.91	21.92	1.10	0.478
		8	34 58	10 50	3 66	21 60	39.74	24 50	1.19	0.507
		9	40.82	9 06	3.93	25 22	39.81	21.98	0.945	0.440
		10	41.68	9 31	3 35	24.39	39 48	23.47	1.12	0.491
		11	37.70	9 63	3.54	22 03	39 61	25 19	1.14	0.501
		12	34.03	9.50	3 79	22 64	39.75	24.32	0.958	0.494

TABLE 10

SUMMARY OF METABOLISM EXPERIMENTS UPON WHICH THE DETERMINATION OF BIOLOGICAL VALUES OF PROTEINS IN THE LEGUMES AND GRASSES IS BASED

Trial No.	Ration	Animal number	Body Weight: Initial Kgm	Body Weight: Final Kgm.	Body Weight: Average Kgm	Feed intake Wet Grams.	Feed intake Dry Grams	Nitrogen intake Grams	Total fecal Nitrogen Grams	Body Nitrogen in feces Grams	Food Nitrogen in feces Grams	Absorbed Nitrogen Grams	Total Nitrogen in urine Grams	Body Nitrogen in urine Grams	Food Nitrogen in urine Grams	Food Nitrogen retained Grams.	Biological value	Average Biological value
1	Cow peas (starting blooming)	1	17.80	18.71	18.26	50,236	5,403	172.78	38.71	22.58	16.13	156.65	114.95	9.95	105.00	51.65	33	33
		2	18.82	19.28	19.05	54,432	5,818	187.33	46.18	24.32	21.86	165.47	126.64	10.38	116.26	49.21	30	
		3	18.71	18.60	18.66	60,896	6,939	221.62	53.66	29.00	24.66	199.96	153.34	10.17	143.17	56.49	28	
		4	18.03	18.71	18.37	48,989	5,317	170.91	35.97	22.23	13.74	157.17	112.28	10.01	102.27	54.90	35	
		5	19.28	19.62	19.45	55,453	5,856	199.27	43.86	24.48	19.38	179.89	151.08	10.60	140.48	39.41	22	
		6	19.73	22.11	20.92	62,370	6,686	211.72	46.35	27.95	18.40	193.32	127.93	11.40	116.53	76.79	40	
2	Cow peas (full-blooming stage)	7	14.29	15.08	14.69	54,772	5,933	236.61	43.66	24.80	18.86	217.75	134.67	8.01	126.66	91.09	42	40
		8	16.22	17.35	16.79	60,102	6,923	260.55	59.27	28.94	30.33	230.22	151.02	9.15	141.87	88.35	38	
		9	18.94	20.41	19.68	68,498	7,895	284.10	61.70	33.00	28.70	255.40	170.11	10.73	159.38	96.02	38	
		10	18.14	19.50	18.82	66,793	7,739	279.55	59.43	32.35	27.08	252.47	159.29	10.26	149.03	103.44	41	
		11	23.47	23.02	23.25	56,247	6,388	247.71	58.27	26.70	31.57	216.14	172.64	12.67	159.97	56.17	26	
		12	25.29	26.54	25.92	72,916	8,135	298.38	63.21	34.00	29.21	269.17	168.60	14.13	154.17	111.70	43	
3	Cow peas (in full pods)	1	19.28	20.19	19.74	50,236	7,802	212.39	52.56	32.61	19.95	192.44	109.95	10.76	99.19	93.25	48	47
		2	19.50	20.19	19.86	46,267	7,041	199.68	43.81	29.43	14.38	185.30	108.47	10.82	97.65	87.65	47	
		3	18.71	20.41	19.56	50,123	7,941	214.71	51.21	33.19	18.02	196.69	114.98	10.66	104.32	92.37	47	
		4	19.73	20.53	20.13	46,494	6,978	198.63	45.51	29.17	16.34	182.29	111.83	10.97	100.86	81.13	45	
		5	21.32	21.32	21.32	49,102	7,514	207.58	52.04	31.41	20.63	186.95	116.51	11.62	104.89	82.06	44	
		6	22.68	23.59	23.14	58,514	8,908	230.86	64.37	37.24	27.13	203.73	119.09	12.61	106.48	97.25	48	
4	Merker grass (after blooming)	7	16.33	16.44	16.39	26,309	5,456	113.33	38.48	22.81	15.67	97.66	54.57	8.93	45.64	52.02	53	47
		8	16.44	17.58	17.01	28,376	5,114	109.81	39.35	21.38	17.97	91.84	57.60	9.27	48.33	43.51	47	
		9	20.75	20.41	20.58	31,298	6,186	120.85	46.15	25.86	20.29	100.56	68.75	11.22	57.53	43.03	43	
		10	19.98	21.43	20.70	34,247	6,945	128,67	47.11	29.03	18.08	110.59	67.74	11.28	56.46	54.13	49	
		11	21.09	22.23	21.66	29,371	5,631	115,13	42.70	23.54	19.16	95.97	71.73	11.80	59.93	36.04	38	
		12	24.04	24.49	24.27	31,752	6,249	121,50	46.92	26.12	20.80	100.70	69.32	13.23	56.09	44.61	45	
5	Merker grass (after blooming)	1	19.62	19.62	19.62	33,793	6,445	146.19	49.07	26.94	22.13	124.06	80.87	10.69	70.18	53.88	43	47
		2	19.73	19.62	19.68	29,030	5,438	133.20	38.81	22.73	16.08	117.12	66.69	10.73	55.96	61.16	52	
		3	18.94	20.30	19.62	32,659	5,897	139.12	48.31	24.65	23.66	115.46	71.13	10.69	63.41	52.02	45	
		5	21.21	20.87	21.04	29,938	5,541	134.53	43.29	23.16	20.13	114.40	69.93	11.17	58.16	55.94	49	
		6	23.47	23.59	23.53	35,154	6,685	149.28	52.06	27.94	24.12	125.16	81.68	12.82	68.86	56.30	45	
6	Yaraguá (N only) full bloom	7	15.88	14.97	15.43	16 217	3,695	27.42	22.25	15.45	6.80	20.62	13.37	8.41	4.96	15.66	76	83
		8	16.44	16.56	16.50	17,918	4,399	30.15	26.03	18.39	7.64	22.51	13.34	8.99	4.35	18.16	81	
		9	20.75	19.96	20.36	19,268	4,888	32.04	24.47	20.43	4.04	28.00	15.57	11.10	4.47	23.53	84	
		10	20.53	20.75	20.64	19,619	4,980	32.39	26.94	20.82	6.12	26.27	16.63	11.25	5.38	20.89	80	
		11	22.57	22.57	22.57	20,515	5,405	34.19	28.11	22.59	5.52	28.67	16.90	12.30	4.60	21.07	84	
		12	26.20	25.86	26.03	20,639	5,399	34.17	28.16	22.57	5.59	28.58	16.88	14.19	2.69	25.89	91	
7	Alfalfa hay	1	19.16	21.55	20.36	8,051	6,888	234.16	76.90	28.79	48.11	186.05	161.77	11.10	150.67	35.38	19	33
		2	19.16	21.32	20.24	8,392	7,155	240.62	74.53	29.91	44.62	196.00	148.20	11.03	137.17	58.83	30	
		3	19.50	22.00	20.75	8,505	7,264	243.25	79.36	30.36	49.00	194.25	162.98	11.31	151.67	42.58	22	
		4	20.19	20.64	20.42	8,165	6,981	236.41	72.01	29.18	42.83	193.58	152.68	11.13	141.55	52.03	27	
		5	20.41	22.00	21.21	8,959	7,694	253.66	78.92	32.16	46.76	206.90	141.91	11.56	130.35	76.55	37	
		6	23.25	25.40	24.33	10 433	8 915	266.69	92.77	37.26	55.51	211.18	160.09	13.26	146.83	91.35	39	
8	Alfalfa hay	7	16.10	18.60	17.35	7 825	7 040	266.38	78.22	29.13	48.79	217.59	139.15	9.46	129.69	87.90	40	39
		8	17.01	18.82	17.92	9 412	8,246	293.52	92.64	34.47	58.17	235.35	117.66	9.77	137.89	97.46	41	
		9	21.21	23.25	22.23	9,639	8,519	320.20	78.91	35.61	43.30	276.90	181.09	12.12	168.97	107.93	39	
		10	20.75	23.70	22.23	10 546	9,530	342.95	104.83	39.84	64.99	277.96	191.24	12.12	179.12	98.84	36	
		11	24.27	26.31	25.29	11 794	10,355	361.51	112.15	43.28	68.87	292.64	195.39	13.78	181.61	111.03	38	
		12	25.86	29.26	27.56	11,227	9 995	353.41	108.49	41.78	66.71	286.70	181.93	15.02	166.91	119.79	42	
9	Alfalfa hay	1	22.11	23.59	22.85	9 866	8,754	311.19	95.25	36.59	58.66	252.53	178.80	12.45	166.35	86.18	34	37
		2	21.89	22.79	22.34	9 299	8,131	299.10	87.62	33.99	53.63	245.47	161.69	12.18	149.51	95.96	39	
		3	20.98	23.36	22.17	9 866	8,623	308.64	88.76	36.04	52.72	255.92	165.12	12.08	153.04	102.88	40	
		4	22.11	22.23	22.17	8,959	7,939	295.34	86.52	33.19	53.33	242.01	178.11	12.08	166.03	76.01	31	
		5	22.45	23.93	23.19	10 093	8 820	312.47	91.27	36.87	54.40	258.07	153.61	12.64	141.00	117.07	45	
		6	24.49	27.90	26.20	12,474	10,909	352.96	111.85	45.60	66.25	286.71	199.19	14.28	184.91	101.83	35	
10	Merker grass (after blooming)	7	16.22	18.60	17.41	32 773	6,508	127.81	40.59	27.20	13.39	111.42	67.99	9.49	58.50	55.92	49	49
		8	16.90	18.60	17.75	34,471	6 887	130.95	44.86	28.79	16.07	114.88	69.64	9.67	59.97	54.91	48	
		9	21.43	23.81	22.62	41 391	8 807	157.49	48.89	34.72	14.17	143.32	72.86	12.33	60.53	82.79	58	
		10	21.66	24.27	22.97	41 617	8,219	156.76	52.58	34.36	18.22	138.54	89.57	12.52	77.05	61.19	44	
		13	18.71	20.41	19.56	34,814	6 952	131.49	42.57	29.06	13.51	117.98	72.20	10.66	61.54	56.44	48	
		14	20.30	20.75	20.53	34 247	6,925	131.27	47.68	28.95	18.73	112.54	72.80	11.19	61.61	50.93	45	
11	2/3 Merker grass + 1/3 pigeon peas (in flower)	1	20.53	22.68	21.61	34 814	6 830	200.67	70.02	28.55	41.47	159.20	102.14	11.78	90.36	68.84	43	45
		2	20.07	21.77	20.92	32,432	6 249	193.81	65.25	26.12	39.13	154.68	87.47	11.40	76.07	78.61	51	
		3	20.07	22.23	21.15	35,948	7,188	201.89	79.26	30.05	49.21	155.68	98.05	11.53	86.52	69.16	44	
		4	20.64	21.89	21.27	32 319	6,517	196.97	64.71	27.24	37.47	159.50	105.84	11.60	94.24	65.26	41	
		5	23.47	22.68	23.08	34,814	6,813	200.46	75.40	28.48	46.92	153.54	98.00	12.58	85.42	68.12	44	
		6	25.63	25.97	25.80	44,453	9 029	247.62	91.03	37.74	53.29	194.33	118.54	14.06	104.48	89.85	46	
12	2/3 Pará grass + 1/3 pigeon peas (in flower)	7	19.73	20.87	20.30	35,608	7,102	174.34	62.33	29.69	32.64	141.70	69.65	11.06	58.59	83.11	59	49
		8	18.94	19.50	19.22	31,525	6 117	163.90	67.60	25.57	42.03	121.87	79.93	10.47	69.46	52.41	43	
		9	25.63	26.20	25.92	43,432	8,557	212.05	80.84	35.77	45.07	166.98	98.04	14.13	83.91	83.07	50	
		10	24.95	25,86	25.41	42 071	8,267	211.45	78.95	34.56	44.39	167.06	98.77	13.85	81.92	82.14	49	
		13	22.00	21.66	21.83	38,896	7,631	204.71	75.79	31.90	43.89	160.82	101.20	11.90	89.30	71.52	44	
		14	23.13	22.45	22.79	39,463	7 857	207.10	76.13	32.84	43.29	163.81	96.75	12.42	84.33	79.48	48	
13	Pará grass (after-blooming stage)	1	20.98	22.91	21.95	31,865	6,262	96.54	39.90	26.18	13.72	82.82	56.30	11.96	44.34	38.48	46	53
		2	20.53	22.11	21.32	31 752	6,237	96.28	36.88	26.07	10.81	85.47	50.91	11.62	39.29	46.18	54	
		3	20.53	22.57	21.55	36,855	7,271	112.53	48.08	30.39	17.69	94.84	57.29	11.74	45.55	49.29	52	
		4	21.21	22.34	21.78	35,494	6,964	111.69	38.76	29.11	9.65	102.04	58.70	11.87	46.83	55.21	54	
		5	24.49	24.38	24.44	37,309	7,391	116.13	44.26	30.89	13.37	102.76	62.10	13.32	48.78	53.98	53	
		6	26.65	28.46	27.56	40,144	7,746	119.82	48.53	32.38	16.15	103.67	60.65	15.02	45.63	58.01	56	
14	Pará grass (after-blooming stage)	7	20.30	21.21	20.76	35,834	6,003	142.42	38.98	25.09	13.89	128.53	67.80	11.31	56.49	72.04	56	53
		8	18.94	19.05	19.00	33,907	5,807	128.34	45.93	24.27	21.66	106.68	68.13	10.36	57.77	48.91	46	
		9	27.10	25.97	26.54	45,020	7,763	165.01	54.22	32.45	21.77	143.24	77.07	14.46	62.61	80.63	56	
		10	25.86	26.20	26.03	49,989	8,593	182.79	57.34	35.92	21.42	161.37	91.40	14.19	77.21	84.16	52	
		13	23.25	22.23	22.74	42,298	7,527	162.18	52.82	31.46	21.36	140.82	80.45	12.39	68.06	72.76	52	
		14	23.36	23.70	23.53	44,793	8,010	167.37	53.37	33.48	19.89	148.08	80.85	12.82	68.03	80.05	54	

TABLE 15

NITROGEN BALANCE DATA WITH PERCENTAGES OF INTAKE COMPUTED FOR ALL THE FEEDING STUFFS WHEN FED TO LAMBS

Trial No.	Item	Animal No.	Feed eaten	Nitrogen consumed	Nitrogen voided in			Nitrogen balance	Intake stored
					Feces	Urine	Total outgo		
			Grams	Grams	Grams	Grams	Grams	Grams	Percent
1	Cow pea (starting blooming)	1	5403	172.78	38.71	114.95	153.66	19.12	11.07
		2	5818	187.33	46.18	126.64	172.82	14.51	7.75
		3	6939	224.62	53.66	153.34	207.00	17.62	7.84
		4	5317	170.91	35.97	112.28	148.25	22.66	13.26
		5	5856	199.27	43.86	151.08	194.94	4.33	2.17
		6	6686	211.72	46.35	127.93	174.28	37.44	17.68
	AVERAGE		6003	194.44	44.12	131.04	175.16	19.28	9.96
2	Cow pea (full-blooming stage)	7	5933	236.61	43.66	134.67	178.33	58.28	24.63
		8	6923	260.55	59.27	151.02	210.29	50.26	19.31
		9	7895	284.10	61.70	170.11	231.81	52.29	18.41
		10	7739	279.55	59.43	159.29	218.72	60.83	21.76
		11	6388	247.71	58.27	172.64	230.91	16.80	6.78
		12	8135	298.38	63.21	168.60	231.81	66.57	22.31
	AVERAGE		7169	267.65	57.59	159.39	216.98	50.84	18.87
3	Cow pea (in full pods)	1	7802	212.39	52.56	109.95	162.51	49.88	23.49
		2	7041	199.68	43.81	108.47	152.28	47.40	23.74
		3	9941	214.71	51.21	114.98	166.19	48.52	22.60
		4	6978	198.63	45.51	111.83	157.34	41.29	20.79
		5	7514	209.58	52.04	116.51	168.55	41.03	19.58
		6	8908	230.86	64.37	119.09	183.46	47.40	20.53
	AVERAGE		8031	210.98	51.58	113.47	165.06	45.92	21.79
4	Merker grass (after blooming)	7	5456	113.33	38.48	54.57	93.05	20.28	17.89
		8	5114	109.81	39.35	57.60	96.95	12.86	11.71
		9	6186	120.85	46.15	68.75	114.90	5.95	4.92
		10	6945	128.67	47.11	67.74	114.85	13.82	10.74
		11	5631	115.13	42.70	71.73	114.43	0.70	0.61
		12	6249	121.50	46.92	69.32	116.24	5.26	4.33
	AVERAGE		5930	118.22	43.45	64.95	108.40	9.81	8.27
5	Merker grass (after blooming)	1	6445	146.19	49.07	80.87	129.94	16.25	11.12
		2	5438	133.20	38.81	66.69	105.50	27.70	20.80
		3	5897	139.12	48.31	74.13	122.44	16.68	11.99
		5	5541	134.53	43.29	69.93	113.22	21.31	15.84
		6	6685	149.28	52.06	81.68	133.74	15.54	10.41
	AVERAGE		6001	140.46	46.31	74.76	120.97	19.50	14.03
7	Alfalfa hay	1	6888	234.16	76.90	161.77	238.67	4.51	
		2	7155	240.62	74.53	148.20	222.73	17.89	7.43
		3	7264	243.25	79.36	162.98	242.34	0.91	0.37
		4	6981	236.41	72.01	152.68	224.69	11.72	4.96
		5	7694	253.66	78.92	141.91	220.83	32.83	12.94
		6	8915	296.69	92.77	160.09	252.86	43.83	14.77
	AVERAGE		7483	250.80	79.08	154.61	233.69	17.11	
8	Alfalfa hay	7	7040	266.38	78.22	139.15	217.37	49.01	18.40
		8	8246	293.52	92.64	147.66	240.30	53.22	18.13
		9	8519	320.20	78.91	181.09	260.00	60.20	18.80
		10	9530	342.95	104.83	191.24	296.07	46.88	13.67
		11	10355	361.51	112.15	195.39	307.54	53.97	14.93
		12	9995	353.41	108.49	181.93	290.42	62.99	17.82
	AVERAGE		8948	323.00	95.87	172.74	268.62	54.38	16.96
9	Alfalfa hay	1	8754	311.19	95.25	178.80	274.05	37.14	11.93
		2	8131	299.10	87.62	161.69	249.31	49.79	16.65
		3	8623	308.64	88.76	165.12	253.88	54.76	17.74
		4	7939	295.37	86.52	178.11	264.63	30.74	10.41
		5	8820	312.47	91.27	153.64	244.91	67.56	21.62
		6	10909	352.99	111.85	199.19	311.04	41.95	11.88
	AVERAGE		8863	313.29	93.55	172.76	266.30	46.99	15.04
10	Merker grass (after blooming)	7	6508	127.81	40.59	67.99	117.58	10.23	8.00
		8	6887	130.95	44.86	69.64	114.50	16.45	12.56
		9	8307	157.49	48.89	72.86	121.75	35.74	22.69
		10	8219	156.76	52.58	89.57	142.15	14.61	9.32
		13	6952	131.49	42.57	72.20	114.77	16.72	12.72
		14	6925	131.27	47.68	72.80	120.48	10.79	8.22
	AVERAGE		7300	139.30	46.20	74.18	121.87	17.42	12.25
11	2/3 Merker grass + 1/3 pigeon peas (in flower)	1	6830	200.67	70.02	102.14	172.16	28.51	14.21
		2	6249	193.81	65.25	87.47	152.72	41.09	21.20
		3	7188	204.89	79.26	98.05	177.31	27.58	13.46
		4	6517	196.97	64.71	105.84	170.55	26.42	13.41
		5	6813	200.46	75.40	98.00	173.40	27.06	13.50
		6	9029	247.62	91.03	118.54	209.57	38.05	15.37
	AVERAGE		7104	207.40	74.28	101.67	175.95	31.45	15.19
12	2/3 Para grass + 1/3 pigeon peas (in flower)	7	7102	171.34	62.33	69.65	131.98	42.36	24.30
		8	6117	163.90	67.60	79.93	147.53	16.37	9.99
		9	8557	212.05	80.84	98.04	178.88	33.17	15.64
		10	8267	211.45	78.95	98.77	177.72	33.73	15.95
		13	7631	204.71	75.79	101.20	176.99	27.72	13.54
		14	7857	207.10	76.13	96.75	172.88	34.22	16.52
	AVERAGE		7589	195.59	73.61	90.72	164.33	31.26	15.99
13	Para grass ([illegible] blooming)	1	6262	96.54	39.90	56.30	96.20	0.34	0.35
		2	6237	96.28	36.88	50.91	87.79	8.49	8.82
		3	7271	112.53	48.05	57.29	105.37	7.16	6.36
		4	6964	111.[illegible]	38.7[illegible]	58.70	97.46	14.23	12.74
		5	7391	116.13	44.26	62.10	106.36	9.77	8.41
		6	7746	119.82	48.53	60.65	109.18	10.64	8.88
	AVERAGE		6979	108.83	42.74	57.66	100.39	8.44	7.59
14	Para grass (after blooming)	7	6003	142.42	38.98	67.80	106.78	35.64	25.02
		8	5807	128.34	45.93	68.13	114.06	14.28	11.13
		9	7763	165.01	54.22	77.07	131.29	33.72	20.44
		10	8593	182.79	57.34	91.40	148.74	34.05	18.63
		13	7527	162.18	52.82	80.45	133.27	28.91	17.83
		14	8010	167.97	53.37	80.85	134.22	33.75	20.09
	AVERAGE		7284	158.12	50.44	77.62	128.06	30.06	18.86

TABLE 16

SUMMARY OF THE NUTRITIVE INDEXES DETERMINED
IN THE EXPERIMENTS PERFORMED DURING THE YEAR 1938-39

Ration	Dates on which trials were performed	Coefficient of apparent digestibility: Dry matter	Crude protein	Crude fat	Crude fiber	N-free extract	Organic matter	Biological value of protein	Net protein value	Nutritive ratio	Ca/P ratio
Cow peas (starting blooming)	Oct. 1 to Oct. 11, 1938	61	77	63	56	75	70	33	0.531	3.48	9.53
Cow peas (full-blooming stage)	Oct. 12 to Oct. 22, 1938	62	79	66	54	74	71	40	0.776	2.94	10.82
Cow peas (in full pods)	Oct. 22 to Nov. 2, 1938	67	76	60	45	81	71	47	0.804	4.76	3.20
Merker grass (after blooming)	Nov. 11 to Dec. 2, 1938	55	66	57	61	58	60	48	0.679	7.98	1.76
Yaraguá grass (N only)	Dec. 16 to Dec. 26, 1938	49	18	37	56	55	53	83	0.149	87.90	2.59
Alfalfa hay (partly dry)	Dec. 27 to Jan. 28, 1939	58	70	25	53	60	59	36	3.81	3.24	5.44
2/3 Merker grass + 1/3 pigeon peas (in bloom)	Feb. 9 to Feb. 19, 1939	53	64	67	24	64	56	45	0.860	4.57	2.12
2/3 Para grass + 1/3 pigeon peas (in bloom)	Feb. 20 to March 2, 1939	51	62	49	41	60	55	49	0.779	5.77	1.87
Para grass (after blooming)	March 3 to March 24, 1939	56	65	51	57	61	60	53	0.649	8.04	1.36
Low-protein ration	May 6 to June 18, 1939	Fecal nitrogen per gram of dry matter ingested = 0.00418						Urinary nitrogen per kgm. of body weight = 0.545			

TABLE 1

SCIENTIFIC AND COMMON NAMES OF GRASSES ANALYZED[a]

Ref. No.	Scientific Name	English Common Name	Spanish Common Name
1	*Andropogon annulatus* Forsk	Railroad grass[1]	
2	" *bicornis* L.	Fox-tail grass, ridging grass	Rabo de gato[3]
3	" *brevifolius* Swartz	Beardgrass	Colchón[1], matojillo[3]
4	*Anthephora hermaphrodita* (L.) Kuntze		
5	*Arundinella confinis* (Schult) Hitchc and Chase	Rat-tail	Rabo de ardilla[1]
6	*Axonopus compressus* (Swartz) Beauv.	Carpet grass, flat-joint grass	Pasto de alfombra[1]
7	*Brachiaria subquadripara*	East Indies grass[1]	
8	*Cenchrus pauciflorus* Benth.	Field sandbur, bur grass[2]	Abrojo
9	*Chloris gayana* Kunth	Rhodes grass	Yerba de Rodes[5]
10	" *inflata* Link	Short-finger grass	Horquetilla morada[1]
11	" *petraea* Swartz	Finger grass	Yerba de deo[2]
12	" *radiata* (L) Swartz	Plush grass	Horquetilla[3], grama de costa[1]
13	*Cymbopogon citratus*	Lemon grass	Yerba limón, limoncillo
14	*Cynodon dactylon* (L.) Pers.	Bermuda grass	Yerba Bermuda, grama, hierba fina, Pepe Ortiz[2]
15	" *plectostachyum*	Giant Bermuda[1]	Bermuda gigante[1]
16	*Coix Lacryma* Jobi, L.	Job's tears, Christ's tears	Camándulas, lágrimas de Job
17	*Dactyloctenium aegyptium* (L.) Richt.	Crowfoot grass, Egyptian grass[3]	Yerba egipcia[2]
18	*Digitaria horizontalis* Willd.	This genus is known collectively as crab or finger grass[5]	Pendejuelo*
19	" *sanguinalis* L.	Crabgrass	Yerba de cangrejo[2]
20	*Echinochloa colonum* (L.) Link	Jungle rice	Arroz del monte
21	" *polystachya* (H. B. K.) Hitchc.	River grass[2]	Yerba de río[2]
22	*Eleusine indica* L.	Goosegrass wire grass[3]	Pata de gallina, piepul, yerba dulce
23	*Eragrostis ciliaris* (L.) Link	Lovegrass	Yerba de amor, ilusión
24	*Eriochloa polystachya* H. B. K.	Malojilla grass	Malojilla[1]
25	" *punctata* (L.) Desv.	Cupgrass	
26	*Gynerium sagittatum* (Aubl.) Beauv.	Wild cane, uva grass[3]	Caña cimarrona[2], caña de la India[3], caña brava[2]
27	*Hymenachne amplexicaulis* (Rudge) Nees.		Trompetilla[2]
28	*Ichnanthus pallens* (Swartz.) Munro.		Carruzo
29	*Ixosphorus unisetus* (Presl.) Schlecht.	Hatico grass	Yerba de Méjico
30	*Lasiacis divaricata* (L.), Hitchc.	Cane grass[3]	Yerba de caña, pito de bejuco
31	" *ruscifolia* (H. B. K.) Hitchc.		Pito de alfombra
32	*Leersia hexandra*, Swartz	Rice grass*	
33	*Leptochloa filiformis* (Lam.) Beauv.	Red sprangleton Arrow grass[5]	
34	" *scabra*. Nees.	River sprangletop[1]	
35	*Lithachne pauciflora* (Swartz) Beauv.		Yerba de la sombra[1]
36	*Melinis minutiflora* Beauv.	Molasses grass	Yerba de melado[2], pasto o zacate gordura, Yaraguá
37	" " "	Molasses grass	Yerba de melado[2], pasto o zacate gordura, Yaraguá
38	*Oriza sativa*, L.	Rice	Arroz
39	*Panicum acuminatum* Swartz.		Yerba de ramillete[1]
40	" *adspersum* Trim.		Arrocillo*
41	" *aquaticum* Poir.	Aquatic grass	Yerba acuática
42	" *fasciculatum* Swartz.	Browntop millet	
43	" *geminatum* Forsk.	Water grass[3]	Yerba de agua
44	" *laxum* Swartz		Malojillo del monte
45	" *maximum*, Jacq.	Guinea grass	Yerba de Guinea
46	" *maximum* var. Borinquen	Borinquen grass[1]	Yerba de Borinquen
47	" " " Gramalote	A variety of Guinea grass[5]	Gramalote[1]
48	" *purpuracens* Raddi.	Para grass	Malojillo
49	" *trichanthum* Nees		Carrucillo[1], ilusión[1]
50	*Paspalum conjugatum* Bergius.	Sour paspalum sour grass, sour grama[1]	Grama amarga, cintillo[2], horquetilla blanca[1]
51	" *decumbens* Swartz.		Pendejuelo*
52	" *distichum* L	Knotgrass, joint grass[3]	Salaillo[1]
53	" *fimbriatum* H. B K.	Panama paspalum	
54	" *laxum* Lam.		Matojo de la arena[1]
55	" *millegrana* Schrad.		Cortadera[1]
56	" *notatum* Flugge.	Bahia grass	Yerba de Bahía[5]
57	" *paniculatum* L.	Hairy grass	Gramilla[2], arrocillo[2], yerba peluda[1]
58	" *plicatulum* Michx.	Sweet grass[1]	Yerba dulce[1]
59	" *virgatum* L.		Cortadero, matojo blanco[1]
60	*Pennisetum glaucum* L.	Pearl millet	Rabo de gato*
61	" *orientalis*	Ecuador grass	Yerba de Ecuador
62	" *purpureum* Schum.	Elephant grass, Napier grass[3]	Yerba elefante
63	" " var. Merker.	Merker grass	Yerba Merker
64	" " var. Merker (after blooming)	Merker grass	Yerba Merker
65	" " var Napier	Imported Napier grass*	Yerba Napier[5]
66	*Polytrias amaura**	Java grass	Yerba de Java
67	*Saccharum spontaneum**	Indian wild sugar cane[5]	Caña de azúcar silvestre[5]
68	*Sacciolepis striata* (L) Nash.	Swamp grass[1]	Yerba de pantano[1]
69	*Setaria barbata* (Lam.) Kunth.	Mary grass	
70	" *geniculata* (Lam.) Beauv.	Knotroot bristlegrass	Cepillo de diente[1]
71	" *vulpiseta* (Lam.) Roem. and Schutt.	Squirrel-tail-grass	Rabo de ardilla[1]
72	*Sorghastrum setosum* (Griseb.) Hitchc.		
73	*Sorghum vulgare* (L.) Pers	Sorghum or sorgo, Guinea corn	Millo, sorgo
74	" " var. sudanensis (Piper), Hitchc.	Sudan grass	Yerba de Sudán
75	*Sporobolus indicus* L.	West Indian rush grass	Matojo[2], cerrillo[2]
76	" *poiretii* (Roem and Schult) Hitchc.	Smutgrass	Matojo de burro[1], rabo de mula[1]
77	*Stenotaphrum secundatum* (Walt.) Kuntze	St. Augustine grass, running-crab grass	Cinta[2], gramón de costa[3], grama blanca[3]
78	*Trichachne insularis* (L.) Nees.	Sour grass	Zorra de limón[3], rabo de zorra[3], barba de indio[3]
79	*Tricholaena repens* (Willd.) Hitchc.	Natal grass	Yerba de Natal
80	*Tripsacum laxum* Nash	Guatemala grass	Yerba Guatemala
81	Unknown	Hato Rey grass	Yerba Hato Rey
82	*Vetiveria zizanioides* Nash	Vetiver grass Khus-khus	Patcholí, pacholí
83	*Zea Mays* L.	Indian corn	Maíz

[a] The grasses were obtained from the Agricultural Experiment Station of the University of Puerto Rico through the courtesy of the Soil Conservation Service

* Common name doubtful.

1 "Observations on Possible Erosion Control Grasses of P. R" By O García Molinari. Soil Conservation, U. S. Department of Agriculture. Vol. IV, No. 11, p. 267, May 1939.

2 "Catálogo de los Nombres Vulgares y Cientificos de Algunas Plantas Puertorriqueñas". By José I. Otero y R. A. Toro. Insular Expt. Sta. Bul. 37, 1931.

3 "Scientific Survey of Porto Rico and the Virgin Islands". Vol. V New York Academy of Science, 1924.

4 Names without reference number were taken from "Manual of the Grasses of the West Indies". By A. S. Hitchcock U S Department of Agriculture. Washington, D. C

5 Names given by Mr José I. Otero, Librarian, Agricultural Experiment Station, University of Puerto Rico, Río Piedras, P R.

TABLE 2

ANALYSES OF THE GRASSES OF PUERTO RICO

Wet basis

Grass No.	Total moisture	Crude protein (N x 6.25)	Ether-soluble extract	Crude fiber	Nitrogen-free extract	Ash	Calcium	Phosphorus
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
1	66.99	1.79	0.59	11.15	16.01	3.47	0.1564	0.0453
2	73.31	1.60	0.40	10.36	12.37	1.96	0.0302	0.0268
3	78.50	1.17	0.41	7.65	10.46	1.81	0.0528	0.0173
4	82.71	1.96	0.27	4.93	6.30	3.83	0.0429	0.0285
5	69.75	1.38	0.54	11.44	14.39	2.50	0.0433	0.0188
6	82.60	2.21	0.33	5.12	7.58	2.06	0.0536	0.0355
7	83.04	2.08	0.64	4.77	7.11	2.36	0.0507	0.0246
8	78.44	3.03	0.77	6.07	9.26	2.43	0.0388	0.0429
9	79.10	2.17	0.93	7.01	9.13	1.66	0.0665	0.0297
10	72.08	2.39	0.66	9.74	12.39	2.74	0.0951	0.0368
11	76.23	2.44	0.59	7.38	10.74	2.62	0.0528	0.0368
12	71.24	3.49	0.65	8.86	13.38	2.38	0.0657	0.0399
13	79.25	1.35	0.91	5.92	11.24	1.33	0.0552	0.0191
14	76.23	3.42	0.81	6.49	10.81	2.24	0.1080	0.0853
15	79.73	2.55	0.42	6.79	8.66	1.85	0.0561	0.0312
16	79.12	2.04	0.85	6.58	9.00	2.41	0.1380	0.0378
17	77.35	1.77	0.49	6.89	11.22	2.28	0.0819	0.0361
18	82.28	2.34	0.43	5.35	7.63	1.97	0.0490	0.0432
19	76.86	2.95	0.64	6.66	9.92	2.97	0.0652	0.0494
20	82.61	2.21	0.42	5.24	7.03	2.49	0.0851	0.0385
21	82.50	2.47	0.42	5.21	7.42	1.98	0.0679	0.0341
22	72.72	2.76	0.90	8.58	12.93	2.11	0.1240	0.0396
23	70.18	1.81	0.68	9.57	15.29	2.47	0.0924	0.0155
24	72.68	1.43	0.80	9.50	13.84	1.75	0.0348	0.0202
25	83.15	2.19	0.45	4.98	7.03	2.20	0.0482	0.0440
26	69.24	3.24	0.48	10.72	11.32	5.00	0.1580	0.0357
27	78.32	2.32	0.46	7.66	9.54	1.70	0.0391	0.0611
28	82.43	2.31	0.46	5.53	6.77	2.50	0.0465	0.0294
29	87.38	1.45	0.44	3.82	5.70	1.21	0.0458	0.0197
30	66.26	3.27	0.64	13.07	13.08	3.68	0.0469	0.0247
31	71.05	3.17	0.73	10.25	11.35	3.45	0.0779	0.0313
32	74.41	3.73	0.64	7.61	9.18	4.43	0.0904	0.0655
33	79.63	2.69	0.42	5.55	7.70	4.01	0.1630	0.0702
34	81.48	2.14	0.52	5.69	8.04	2.13	0.0610	0.0445
35	61.94	3.95	1.07	11.46	14.34	7.24	0.1200	0.0472
36	75.56	1.56	0.90	9.19	11.33	1.46	0.0648	0.0301
37	64.73	1.17	1.06	13.63	16.97	2.44	0.1010	0.0705
38	80.48	3.49	0.59	5.45	7.70	2.29	0.0406	0.0451
39	65.67	3.43	1.04	8.68	13.76	7.42	0.1007	0.0476
40	76.97	2.13	0.61	5.51	9.14	5.64	0.0975	0.1340
41	84.71	1.75	0.56	4.28	7.28	1.42	0.0292	0.0302
42	79.05	2.08	0.50	6.04	9.69	2.64	0.1223	0.0490
43	80.82	1.95	0.37	6.01	8.07	2.78	0.0286	0.0213
44	79.01	2.32	0.60	6.09	9.09	2.89	0.0359	0.0242
45	72.44	1.17	0.71	11.50	11.94	2.24	0.0582	0.0162
46	75.60	2.68	0.60	9.34	9.29	2.49	0.0681	0.0412
47	72.05	2.17	0.53	11.09	11.99	2.17	0.0706	0.0297
48	77.37	1.70	0.54	7.59	11.04	1.76	0.0678	0.0204
49	81.35	2.64	0.68	5.63	6.64	3.06	0.0578	0.0246
50	78.32	2.14	0.56	7.22	10.03	1.73	0.0539	0.0241
51	80.14	2.13	0.42	5.82	8.33	3.16	0.0439	0.0306
52	76.42	2.25	0.93	7.91	10.71	1.78	0.0512	0.0334
53	85.01	1.31	0.37	4.60	6.89	1.82	0.2445	0.0348
54	72.69	2.85	0.57	8.49	11.61	3.79	0.1133	0.0292
55	76.67	1.43	0.63	8.54	11.15	1.58	0.0285	0.0203
56	75.60	2.41	0.64	7.07	11.23	3.05	0.0402	0.0329
57	79.95	1.27	0.65	7.07	9.00	2.06	0.0776	0.0580
58	77.48	2.21	0.47	6.34	10.29	3.21	0.0961	0.0240
59	77.43	1.39	0.68	7.80	11.08	1.62	0.0242	0.0201
60	80.86	2.67	0.49	6.31	7.91	1.76	0.0404	0.0339
61	84.77	1.87	0.53	4.72	6.77	1.34	0.0522	0.0218
62	74.00	3.06	0.96	8.73	11.20	2.05	0.0504	0.0394
63	73.06	3.32	1.13	9.59	10.69	2.21	0.0692	0.0378
64	76.17	2.06	0.74	8.60	10.00	2.43	0.0805	0.0486
65	77.79	2.65	0.51	7.96	9.39	1.70	0.0443	0.0378
66	83.42	1.87	0.48	5.13	7.45	1.65	0.0491	0.0363
67	68.18	1.28	0.67	12.78	15.16	1.93	0.0545	0.0329
68	85.41	2.03	0.41	3.79	5.95	2.41	0.0325	0.0251
69	81.64	2.40	0.62	5.59	8.09	1.66	0.0327	0.0316
70	73.68	1.97	0.64	8.59	11.22	3.90	0.0839	0.0284
71	80.68	2.15	0.63	6.75	7.73	2.06	0.0535	0.0510
72	68.42	1.82	0.51	12.37	14.63	2.25	0.0369	0.0269
73	77.30	2.03	0.83	6.91	11.04	1.89	0.0506	0.0651
74	73.80	2.83	1.03	8.11	11.39	2.84	0.1960	0.0781
75	65.16	1.66	0.57	12.99	16.85	2.77	0.1584	0.0787
76	67.31	3.29	0.91	11.69	14.16	2.64	0.0687	0.0451
77	83.20	2.26	0.36	4.46	6.53	3.19	0.0534	0.0298
78	82.60	2.10	0.44	6.15	6.83	1.88	0.0559	0.0268
79	76.00	2.10	0.74	9.89	9.69	1.58	0.0521	0.0214
80	81.66	1.94	0.42	6.84	8.09	1.41	0.0288	0.0266
81	84.12	1.73	0.46	3.98	6.50	3.21	0.0359	0.0221
82	68.16	1.47	0.57	13.25	14.84	1.71	0.0402	0.0238
83	83.07	1.97	0.48	4.81	8.51	1.16	0.0262	0.0344

TABLE 3

ANALYSES OF THE GRASSES OF PUERTO RICO

Dry basis

Grass No.	Total solids	Crude protein (N x 6.25)	Ether-soluble extract	Crude fiber	Nitrogen-free extract	Ash	Calcium	Phosphorus	Ca:P ratio
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	
1	33.01	5.44	1.80	33.79	48.46	10.51	0.476	0.138	3.45
2	26.69	6.00	1.50	38.83	46.31	7.36	0.113	0.1004	1.13
3	21.50	5.42	1.93	35.60	48.64	8.41	0.246	0.0808	3.04
4	17.29	11.31	1.59	28.50	36.44	22.16	0.248	0.165	1.50
5	30.25	4.55	1.80	37.83	47.54	8.28	0.143	0.0621	2.30
6	17.40	12.69	1.91	29.42	43.57	12.41	0.306	0.203	1.51
7	16.96	12.25	3.78	28.10	41.95	13.92	0.299	0.145	2.06
8	21.56	14.06	3.56	28.13	43.00	11.25	0.199	0.180	1.11
9	20.90	10.38	4.43	33.55	43.69	7.95	0.318	0.142	2.24
10	27.92	8.56	2.35	34.90	44.36	9.83	0.341	0.132	2.58
11	23.77	10.25	2.47	31.06	45.20	11.02	0.222	0.155	1.43
12	28.76	12.13	2.27	30.80	46.54	8.26	0.229	0.139	1.65
13	20.75	6.50	4.38	28.55	54.15	6.42	0.265	0.0918	2.89
14	23.77	14.38	3.40	27.29	45.51	9.42	0.456	0.312	1.46
15	20.27	12.56	2.07	33.52	42.71	9.14	0.277	0.154	1.80
16	20.88	9.75	4.06	31.51	43.15	11.53	0.662	0.181	3.66
17	22.65	7.81	2.17	30.42	49.52	10.08	0.363	0.160	2.27
18	17.72	13.19	2.43	30.17	43.20	11.01	0.277	0.244	1.14
19	23.14	12.75	2.75	28.76	42.89	12.85	0.281	0.213	1.32
20	17.39	12.69	2.44	30.14	40.39	14.34	0.489	0.221	2.21
21	17.50	14.13	2.40	29.78	42.37	11.32	0.305	0.195	1.56
22	27.28	10.13	3.30	31.44	47.41	7.72	0.454	0.145	3.13
23	29.82	6.08	2.28	32.09	51.26	8.29	0.307	0.0523	5.87
24	27.32	5.25	2.93	34.76	50.65	6.41	0.128	0.0742	1.73
25	16.85	13.00	2.67	29.54	41.73	13.06	0.287	0.262	1.11
26	30.76	10.51	1.57	34.86	36.79	16.27	0.513	0.116	4.42
27	21.68	10.69	2.14	35.31	44.02	7.84	0.182	0.284	0.64
28	17.57	13.13	2.60	31.48	38.54	14.25	0.264	0.167	1.58
29	12.62	11.50	3.48	30.30	45.15	9.57	0.365	0.157	2.32
30	33.74	9.69	1.89	38.74	38.76	10.92	0.139	0.0732	1.90
31	28.95	10.94	2.52	35.41	39.21	11.92	0.269	0.108	2.49
32	25.59	14.56	2.51	29.74	35.88	17.31	0.353	0.256	1.38
33	20.37	13.19	2.06	27.23	37.84	19.68	0.800	0.344	2.33
34	18.52	11.56	2.82	30.71	43.50	11.41	0.329	0.240	1.37
35	38.06	10.38	2.80	30.10	37.71	19.01	0.314	0.124	2.53
36	24.44	6.38	3.31	37.62	46.70	5.99	0.265	0.123	2.15
37	35.27	3.31	3.01	38.64	48.11	6.93	0.287	0.200	1.44
38	19.52	17.88	3.04	27.93	39.41	11.74	0.208	0.231	0.90
39	34.33	10.00	3.02	25.28	40.08	21.62	0.294	0.139	2.12
40	23.03	9.25	2.63	23.94	39.68	24.50	0.424	0.583	0.727
41	15.29	11.44	3.62	27.98	47.68	9.28	0.190	0.127	1.50
42	20.95	9.94	2.37	28.81	46.35	12.53	0.585	0.239	2.44
43	19.18	10.19	1.91	31.32	42.10	14.48	0.149	0.111	1.34
44	20.99	11.06	2.86	29.01	43.32	13.75	0.171	0.115	1.49
45	27.56	4.26	2.57	41.74	43.31	8.12	0.212	0.0591	3.59
46	24.40	11.00	2.47	38.27	38.05	10.21	0.277	0.168	1.65
47	27.95	7.75	1.91	39.68	42.91	7.75	0.252	0.106	2.38
48	22.63	7.50	2.37	33.52	48.83	7.78	0.300	0.0902	3.33
49	18.65	14.13	3.67	30.18	35.60	16.42	0.310	0.132	2.35
50	21.68	9.88	2.58	33.58	45.96	8.00	0.244	0.109	2.24
51	19.86	10.75	2.10	29.29	41.95	15.91	0.221	0.154	1.44
52	23.58	9.56	3.93	33.53	45.42	7.56	0.218	0.142	1.54
53	14.99	8.75	2.46	30.69	45.99	12.11	1.630	0.232	7.03
54	27.31	10.44	2.07	31.07	42.53	13.89	0.415	0.107	3.88
55	23.33	6.11	2.69	36.61	47.80	6.79	0.122	0.0869	1.40
56	24.40	9.88	2.63	28.96	46.03	12.50	0.165	0.135	1.22
57	20.05	6.31	3.23	35.28	44.93	10.25	0.388	0.290	1.34
58	22.52	9.81	2.07	28.17	45.70	14.25	0.428	0.107	4.00
59	22.57	6.16	3.02	34.56	49.09	7.17	0.107	0.0889	1.20
60	19.14	13.94	2.54	32.98	41.36	9.18	0.211	0.177	1.19
61	15.23	12.25	3.47	31.01	41.49	8.78	0.342	0.143	2.39
62	26.00	11.75	3.69	33.50	43.17	7.89	0.193	0.151	1.28
63	26.94	12.31	4.19	35.60	39.71	8.19	0.258	0.141	1.83
64	23.83	8.63	3.12	36.10	41.94	10.21	0.380	0.204	1.69
65	22.21	11.94	2.31	35.86	42.24	7.65	0.219	0.170	1.29
66	16.58	11.25	2.87	30.96	44.97	9.95	0.296	0.219	1.35
67	31.82	4.03	2.12	40.15	47.62	6.08	0.171	0.103	1.66
68	14.59	13.94	2.84	25.97	40.72	16.53	0.223	0.172	1.30
69	18.36	13.06	3.36	30.42	44.14	9.02	0.280	0.172	1.63
70	26.32	7.50	2.43	32.65	42.59	14.83	0.319	0.108	2.95
71	19.32	11.13	3.25	34.94	40.02	10.66	0.277	0.264	1.05
72	31.58	5.75	1.63	39.18	46.32	7.12	0.117	0.0853	1.37
73	22.70	8.94	3.67	30.46	48.62	8.31	0.223	0.287	0.78
74	26.20	10.81	3.94	30.94	43.46	10.85	0.749	0.299	2.51
75	34.84	4.76	1.65	37.28	48.36	7.95	0.455	0.226	2.01
76	32.69	10.06	2.78	35.77	43.30	8.09	0.210	0.138	1.52
77	16.80	13.44	2.16	26.64	38.76	19.00	0.319	0.178	1.79
78	17.40	12.06	2.49	35.32	39.35	10.78	0.321	0.154	2.08
79	24.00	8.75	3.07	41.22	40.36	6.60	0.218	0.0895	2.44
80	18.34	10.56	2.31	37.32	42.14	7.67	0.157	0.145	1.08
81	15.88	10.88	2.91	25.05	40.94	20.22	0.226	0.139	1.63
82	31.84	4.61	1.79	41.62	46.60	5.38	0.126	0.0746	1.69
83	16.93	11.63	2.85	28.36	50.33	6.83	0.155	0.203	0.76

TABLE 11

DIGESTIBLE NUTRIENTS IN 100 LBS. OF LEGUMES AND GRASSES AS CUT

Trial No.	Ration	Digestible Nutrients						Nutritive ratio
		Dry matter	Crude protein	Carbohydrates		Ether-soluble extract	Total * digestible nutrients	
				Crude fiber	N-free extract			
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	
1	Cow pea (starting blooming)	7.11	1.61	1.73	3.10	0.34	7.21	3.48
2	Cow pea (full-blooming stage)	7.56	1.94	1.60	3.18	0.41	7.64	2.94
3	Cow pea (in full pods)	10.83	1.71	2.24	5.18	0.32	9.85	4.76
4	Merker grass (after blooming)	13 67	1.30	5.46	5.73	0.41	13.41	9.32
5	do.	12.16	1.67	4.14	5.56	0.39	12.25	6.34
6	Yaraguá grass (full bloom)	15.48	0.18	6.80	8.37	0.29	16.00	87.90
7	Alfalfa hay	48.17	10.43	15.99	17.15	0.64	45.01	3.32
8	do.	49.62	11.00	18.10	15.27	0.57	45.65	3.15
9	do.	49 52	9.98	15 05	17.86	0.24	43.43	3.35
10	Merker grass (after blooming)	12.07	1.31	4.79	5.21	0.37	12.14	8.27
11	2/3 Merker grass + 1/3 pigeon peas (in flower)	11.58	1.91	1.70	5.68	0.60	10.64	4.57
12	2/3 Para grass + 1/3 pigeon peas (in flower)	10.92	1.59	2.78	5.71	0.30	10.76	5.77
13	Para grass (after blooming)	11.95	1.04	3.98	6.03	0.28	11.68	10.23
14	do.	10.03	1.41	2.66	5.06	0.23	9.65	5.84

* Total digestible nutrients including fat x 2.25.

TABLE 12

DIGESTIBLE NUTRIENTS PRODUCED PER CUERDA* OF GREEN LEGUMES AND GRASSES

Trial No.	Ration	Yield per cuerda	Dry matter	Crude protein (N x 6.25)	Crude fiber	N-free extract	Ether-soluble extract	Total digestible matter
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
1	Cow pea (starting blooming)	22.200	1,578	357	384	688	75	1,598
2	Cow pea (full-blooming stage)	22,200	1,678	431	355	706	91	1,697
	AVERAGE	22,200	1,628	394	370	697	83	1,648
3	Cow pea (full pods)	16,400	1,776	280	367	850	52	1,614
4	Merker grass (after blooming)	64,000	8,749	832	3,494	3,667	262	8,583
5	do.	64,000	7,782	1,069	2,650	3.558	250	7,840
	AVERAGE	64,000	8,266	951	3,072	3,613	256	8,212
6	Yaraguá grass (full bloom)	42,000	6,502	76	2,855	3,515	122	6,722
7	Alfalfa hay	13,600	6,551	1,418	2,175	2,332	87	6,121
8	do.	13,600	6,748	1,496	2,462	2,077	78	6,211
9	do.	13.600	6,735	1,357	2,047	2,429	33	5,907
	AVERAGE	13,600	6,678	1,424	2,228	2,279	66	6,080
10	Merker grass (after blooming)	64,000	7,725	838	3,066	3,334	237	7,771
13	Para grass (after blooming)	56,000	6,692	582	2,229	3,377	157	6,541
14	do.	56,000	5,617	790	1,490	2,834	129	5,404
	AVERAGE	56,000	6,155	686	1,860	3,106	143	5,973

* Land measure equivalent to 0.9712 acre.

TABLE 13

YIELD OF CALCIUM AND PHOSPHORUS PER CUERDA* AND PER TON OF GREEN LEGUMES AND GRASSES°

Trial No.	Ration	Green forage per cuerda	Dry forage per cuerda	Yield per cuerda		Yield per ton	
				Calcium	Phosphorus	Calcium	Phosphorus
		Tons	Pounds	Pounds	Pounds	Pounds	Pounds
1	Cow pea (starting blooming)	11.1	2,589	52.39	5.48	4.72	0.494
2	Cow pea (full-blooming stage)	11.1	2.708	80.36	5.71	7.24	0.514
	AVERAGE	11.1	2.649	66.38	5.60	5.98	0.504
3	Cow pea (in full pods)	8.2	2,650	28.54	11.81	3.48	1.44
4	Merker grass (after blooming)	32.0	15,354	52.80	29.50	1.65	0.922
5	do.	32.0	14,963	57.92	27.07	1.81	0.846
	AVERAGE	32.0	15,159	55 36	28.29	1.73	0.884
6	Yaraguá grass (full bloom)	21.0	13,268	45.36	17.51	2.16	0.834
7	Alfalfa hay	6.8	11.492	133 28	26.11	19.60	3.84
8	do.	6.8	11,635	132.60	24.21	19.50	3.56
9	do.	6.8	11,612	140.08	24.48	20.60	3.60
	AVERAGE	6.8	11.580	135.32	24.94	19.90	3.67
10	Merker grass (after blooming)	32.0	13,555	37.76	27.39	1.18	0.856
13	Para grass (after blooming)	28.0	11,542	28.56	24.47	1.02	0.874
14	do.	28.0	10,405	35.28	22.79	1.26	0.814
	AVERAGE	28.0	10,974	31.92	23.63	1.14	0.844

* Unit of land measure equivalent to 0.9712 acre.

° Yields obtained from the Experiment Station.

TABLE 14

NET PROTEIN VALUES OF THE LEGUMES AND GRASSES FED SINGLY AND IN COMBINATION TO LAMBS

Wet basis

Trial No.	Item	Protein in feed consumed	Coefficient of apparent digestibility	Digestible protein	Average biological value of digestible protein	Net protein content
		Percent		Percent		Percent
1	Cow pea (starting blooming)	2.09	77	1.61	33	0.531
2	Cow pea (full-blooming stage)	2.45	79	1.94	40	0.776
3	Cow pea (in full pods)	2.25	76	1.71	47	0.804
4	Merker grass (after blooming)	2.07	63	1.30	47	0.611
5	do.	2.49	67	1.67	47	0.785
10	do.	1.95	67	1.31	49	0.642
	AVERAGE				48	0.679
6	Yaraguá grass	0.99	18	0.18	83	0.149
7	Alfalfa hay	15.11	69	10.43	33	3.44
8	do.	15.72	70	11.00	39	4.29
9	do.	14.25	70	9.98	37	3.69
	AVERAGE	15.03	70	10.47	36	3.81
11	2/3 Merker grass + 1/3 pigeon peas (in flower)	2.99	64	1.91	45	0.860
12	2/3 Para grass + 1/3 pigeon peas (in flower)	2.56	62	1.59	49	0.779
13	Pará grass (after blooming)	1.70	61	1.04	53	0.551
14	do.	2.07	68	1.41	53	0.747
	AVERAGE	1.89	65	1.23	53	0.649

TABLE 17

VITAMIN A ACTIVITIES OF GRASSES AND LEGUMES
(SHERMAN UNITS)

	Vitamin A unit per gram
"Yaraguá" grass, whole, air-dried	33
Merker grass, whole, air-dried	50
Alfalfa hay, whole, air-dried*	10
Cow peas, pod stage, whole, air-dried	58
Cow peas, flower stage, whole, air-dried	200
Velvet beans, flower stage, whole, air-dried	200
Soy beans, flower stage, whole, air-dried	200
Soy beans, pod stage, whole, air-dried	100

* Dried in the field. All others were dried in the laboratory.

CHEMICAL ANALYSES OF GRASSES[1]

By *Joseph H. Axtmayer*, *G. Rivera Hernández* and *D. H. Cook* with the technical assistance of *José A. Goyco* and *M. C. de Fernández*[2]

From the Department of Chemistry of the School of Tropical Medicine, San Juan, Puerto Rico and the Department of Chemistry of the Agricultural Experiment Station, Río Piedras, Puerto Rico.

The object of this study was to find through the medium of a systematic survey, grasses which would be worthwhile a trial in our studies of the nutritive values of forage crops of Puerto Rico. Although the findings from a chemical analysis of a grass do not yield all the data necessary for judging its nutritive value, nevertheless, some light is shed upon its possibilities. Grasses of good nutritive qualities with root systems capable of reducing soil erosion would be of double value to the agricultural economics of the Island.

Puerto Rico imports large quantities of mixed feed concentrates used by the dairy industry. Even so, the milk production is insufficient to meet the needs of the inhabitants of the Island, were each individual to receive the daily amount considered adequate by our present knowledge of optimum nutritional requirements. It is also expensive, considering the income of the lower class of people. We see no reason why uncultivated regions could not be used to produce crops which could be used as forage, not only for grazing, but for cutting and mixing with other crops in the preparation of concentrates.

MATERIALS

All the grasses analyzed had been cut during the blooming stage with the exception of sample 64, same grass as sample 63,

1 Cooperative project between the School of Tropical Medicine and the Agricultural Experiment Station.

2 Mr. G. L. Crawford, Chief, Soil Conservation Service in Puerto Rico, and Dr. H. W. Alberts cooperated by furnishing samples of varieties and species and also valuable agronomic data.

which was cut during the after-blooming stage. Our reason for collecting the grasses for analysis during the blooming stage was to obtain comparable samples. Although it is known that an actively growing unmature grass, contains more protein and more total digestible nutrients than the more mature plants, the flowering stage was selected for the sake of uniformity.

METHODS OF ANALYSIS

The samples were brought to the laboratory as soon as cut. They were then cleaned, cut into smaller sizes, weighed and placed in a large horizontal flow, forced-air oven for the moisture determinations. When dry, they were ground in a Wiley mill, and the powder stored in air-tight bottles for the determinations of the other constituents. The analyses were performed according to the methods of the Official Agricultural Chemists. All analyses for a given constituent were performed in duplicate.

DISCUSSION

The analyses of the grasses as reported on the dry basis show that some are quite rich in total crude protein, and would yield a hay of some nutritional value. Those yielding a percentage of protein above ten (10) could be used for this purpose.

They are low in ether-soluble extract (fat) and high in crude fiber, as is to be expected. The nitrogen-free extract (carbohydrates) averages around 45-50% and is a good source of energy.

The most favorable ratio of calcium to phosphorus for growth and bone formation is between 2 and 1 and 1 and 2. With the amount of ultraviolet radiation available throughout the year in the sunshine of Puerto Rico, an abundance of vitamin D for the mobilization of the calcium and phosphorus is assured. The calcium and phosphorus ratios of the grasses studied are all narrow and within the limits of profitable utilization.

Abundance of all the other vitamins is also a certainty in the fresh grasses but may be reduced when these are dried.

Nutritional studies which have been planned include some of these grasses, to be used either fresh, as cut, or as hay, in the experimental rations. The formulation of a cheap ration, nutritionally adequate, consisting of crops grown in Puerto Rico would be of great help in the production of cheap milk which is of such great importance in human dietaries.

SUMMARY

Chemical analyses of eighty-three grasses, calculated on the wet and dry basis, are reported. Their composition is discussed from a nutritional point of view.

Scientific, English and Spanish common names of the grasses are also given.

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THE BEAN POD BORERS IN PUERTO RICO

By *L. B. Scott*, United States Department of Agriculture, Bureau of Entomology and Plant Quarantine

Introduction

On April 5, 1935, certain funds were made available for the study of insects in Puerto Rico, and part of the amount allotted was assigned to the study of three species of pod borers[1] which commonly attack the pods of wild and cultivated legumes. The work was planned to include investigations of control measures, life histories, populations, distribution, and host plants. Although the principal vegetable-producing area in Puerto Rico is located near San Juan, on the northeastern end of the Island, the presence of the Puerto Rico Agricultural Experiment Station[2] at the extreme western end offered many advantages there which would not have been available elsewhere, and much of the work was done there.

Dry beans for local consumption are produced in practically all parts of the Island, although very few are found in the extreme western end; and green beans are grown in the San Juan and Isabela vegetable-producing areas for local use and for shipment to the mainland. It was expected that lima beans would be found in rather large quantities, but because of losses resulting from pod borers and disease, and because of the restrictions on the export

1. *Maruca testulalis* (Gayer), *Etiella zinckenella* (Treitschke) (lima bean pod borer), and *Fundella cistipennis* (Dyar) (Caribbean pod borer).

2. The writer wishes to express his appreciation of the helpful spirit of cooperation shown by Atherton Lee, Director of the Station. Mr. Lee made it possible for Wallace Bailey, Associate Physiologist at the Station, to coordinate much of his work with that done by the author, thereby enabling the latter to conduct certain insecticide studies which he would otherwise have been unable to complete. Dr. Alfred Watson, Biometrician at the Station, aided greatly in analyzing the data from several experiments. The cooperation afforded by Luis A. Serrano, Agronomist in charge of the Insular Experiment Station at Isabela, is gratefully acknowledged. The writer also wishes to acknowledge the helpful attitude shown by Dr. George N. Wolcott, Entomologist at the Insular Experiment Station at Río Piedras.

of diseased and wormy pods, this type of bean has almost disappeared from the Island. There is reason to believe that lima beans might again become a profitable crop if a satisfactory control for pod borers could be found.

Reports of previous workers (1) (2) (3) indicate that *Maruca testulalis* is not ordinarily found in large numbers in Puerto Rico. For some unexplained reason this species was found far more numerous in cultivated legumes during most of the period of these investigations[3] than either *Etiella zinckenella* or *Fundella cistipennis*, and in some cases *M. testulalis* was almost entirely responsible for the total destruction of large fields of beans. Despite the fact that *M. testulalis*, which is not known to occur on the mainland, is not ordinarily a major pest in Puerto Rico, this species is of great importance to the growers, since its presence, even in small numbers, in beans intended for export to the mainland, has necessitated the placing of certain restrictions on the shipment of green beans.

Distribution and Seasonal Histories

The three species of pod borers were present in all parts of the Island, although they were much more numerous in the lowland near the coast, where beans are produced in large quantities, than in the mountainous sections of the interior, where host plants are comparatively scarce. *Maruca testulalis* was by far the most injurious of the three species during the period of these investigations. *Etiella zinckenella* may actually have been as numerous as *M. testulalis*, but the former was found largely in the pods of wild legumes, particularly those of *Crotalaria incana* L., which grow in practically every part of the Island. *Fundella cistipennis* was present in much smaller numbers than either of the other species, and its activities were confined largely to the pods and vines of the cowpea *Vigna unguiculata* (L.) Walp.

Etiella zinckenella was present in at least moderate numbers throughout the year, although it was much less numerous in the dry winter months than in the humid months of summer. *Fundella cistipennis*, the least numerous of the three species, was also present during the entire year, but it was found in greatly reduced numbers during the winter months when green beans were being

3. July 1935 to October 1936.

exported to the mainland. This species, which during most of the year prefers cowpeas to all other host plants, was attracted in small numbers during the winter months to lima beans, which had in former years been grown in moderately large quantities. *Maruca testulalis* was most abundant in October, when it was found in great numbers in all kinds of cultivated beans. The most severe infestations were found in the vicinity of Yauco, on the south shore, and at Isabela, in the northwest corner of the Island. The infestation diminished gradually during the latter part of October and very rapidly in November, and practically disappeared in December, particularly on the south shore of the Island where the winter rainfall is very light. On the north shore, however, where the winter precipitation is somewhat greater, occasional larvae of *M. testulalis* were found in the pods of string and lima beans. The infestation remainded very low through the first 5 months of the year, but in June it increased rapidly, reaching its maximum early in October.

Observations by the author indicated that *Etiella zinckenella* was present during the winter months in slightly greater numbers than *M. testulalis*, although previous investigators (1) have found that the former practically disappears early in January and that the infestation remains very low until late in the spring. *E. zinckenella* was more numerous than *M. testulalis* in wild legumes, particularly in *Crotalaria incana*, but it was found commonly in cultivated hosts also. At no time during the course of the investigations herein reported did *E. zinckenella* cause damage even approaching the total destruction of a crop of beans. *M. testulalis*, on the other hand, caused very serious damage in hundreds of large fields of beans in the vicinity of Yauco, on the south shore, and near Isabela, on the north shore, the loss being total in several fields.

The third species, *Fundella cistippennis*, was found less abundant than either of the other species. It was present, however, in small numbers during the winter months in beans intended for export, thereby necessitating the inspection on the farm of all beans presented for shipment to the mainland.

Host Plants

Of *Maruca testulalis* (Geyer)

Maruca testulalis is essentially a pest of cultivated legumes, although it was often found infesting the bay bean (*Canavalia maritima* (Aubl.) Thou.), a wild legume which grows luxuriantly on most of the beaches of Puerto Rico, producing very large and fibrous pods. The cowpea *Vigna unguiculata*, which grows both wild and under cultivation in Puerto Rico, was also infested by *M. testulalis*; but the infestation was never severe. Other wild hosts were occasionally attacked, but this species confined its activities largely to cultivated hosts.

Of *Etiella zinckenella* (Treitschke)

In contrast to *Maruca testulalis*, *Etiella zinckenella* is primarily a pest of wild hosts, although it was found in great numbers in all types of cultivated beans. It was present during the entire period of the investigation in the pods of *Crotalaria incana*, one of the commonest of several wild species of *Crotalaria* found on the Island, but the pods of *C. retusa* L. were not found infested by any of the pod borers. *E. zinckenella* was observed in lima beans, string beans, and the native red and white beans, but in these hosts it was usually much less numerous than *M. testulalis*.

Of *Fundella cistipennis* (Dyar)

The favorite host of *Fundella cistipennis* in Puerto Rico is undoubtedly the cowpea *Vigna unguiculata*, which grows both wild and cultivated in all coastal portions of the Island. Lima beans were attacked, particularly during the winter months, but the infestation in this host was never severe. The bay bean (*Canavalia maritima*) and the sword bean (*C. ensiformis* (L.) D.C.), the first a wild legume found on most of the beaches and the second an excellent leguminous soiling crop, were often moderately infested. The pods of *Cassia occidentalis* L., a wild shrub found in many pastures, were also attacked.

Suspected Hosts

Several other plants, because of their similarity to plants

known to be infested by one or more of the pod borers, were strongly suspected of being hosts of these insects. *Crotalaria retusa* is very similar to *C. incana,* the favorite host of *Etiella zinckenella,* and it seemed probable that this species would be found infesting the former plant; but examination of more than 10,000 pods of *C. retusa* failed to disclose the presence of any pod borers. Another *Crotalaria, C. stipularia* Desv., also was found to be free from infestation. The pods of the wild lima bean *Phaseolus lunatus* L. are very similar to those of the cultivated type, but the former were never found infested. Pods from several tree legumes were examined from time to time, but no infestation was found in them. Bolls and squares from wild cotton (*Gossypium hirsutum* L.) and the fruit of the maga tree (*Montezuma speciosissima* Sesse and Moç.) were examined at many points on the Island, but no pod borer infestation was noted.

Coccinia cordifolia Cogn., one of the plants brought to Puerto Rico in connection with the study of rotenone-bearing plants, bears small cucumber-like fruits, none of which was found to be infested. Pods from *Tephrosia vogelii* Hook f., another species introduced for study of its rotenone content, were found to be moderately infested by *Etiella zinckenella.*

Character of Damage Caused by Pod Borers

The pod borers, as their name denotes, have the habit of boring into the pods of various wild and cultivated plants. The name fails to suggest, however, that the borers commonly attack the blossoms of many leguminous plants and that the stems of some of these plants are also damaged. There is reason to believe that the damage to blossoms and very small pods causes greater losses than the more noticeable damage to large pods. The stems are not ordinarily attacked, although the insects, particularly *Fundella cistipennis,* often are found in large numbers in the stems of the cowpea *Vigna unguiculata.* The stems of other plants are attacked occasionally, but only when the insects become so numerous as to destroy all available pods.

The females deposit most of their eggs on or near the blossoms and blossom buds, thus assuring the newly hatched larvae

a source of food for several days. These young larvae feed first upon the blossoms, causing many of them to drop to the ground, and later they attack the small pods, many of which also drop. It was not uncommon to find 100 or more blossoms and very small pods on the ground under a single hill of pole lima beans. The majority of these blossoms and pods showed evidence of having been damaged by pod borers.

While the three species of pod borers cause essentially the same type of injury, it is interesting to note that the larvae of *Maruca testulalis* invariably keep exit holes open in the sides of pods which they infest, and through these holes they force the feces, or waste material, which would otherwise accumulate within the pod. These feces often collect conspicuously on the outside of infested pods, facilitating the detection of those that are wormy (fig. 1). The other species leave almost no outside evidence of

Fig. 1. Green bean showing typical exit hole of larva of *Maruca testulalis.*

their presence except that infested pods sometimes become flaccid and wrinkled and often have a watery appearance, making them the more readily detected.

When small pods are attacked the entire contents are usually consumed (fig. 2), whereas the larger pods of lima beans and cow-

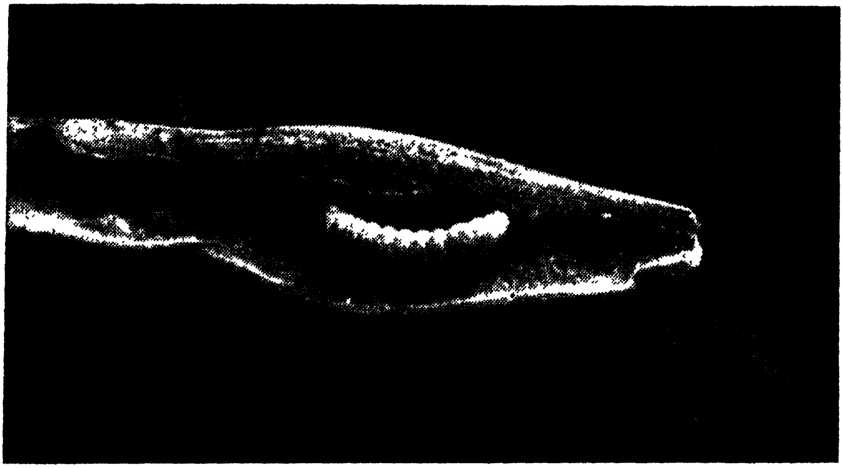

Fig. 2 Interior of bean pod containing *Maruca testulalis* larva.

peas may be only partially eaten. Regardless of the number of borers attacking a pod, however, the loss is usually total, since the infested pod becomes juicy and emits an unpleasant odor. The presence of a few infested pods in beans intended for local consumption is not particularly objectionable, since these beans usually reach the consumer before the infested pods have deteriorated sufficiently to spoil the others. A few infested pods in beans intended for export, however, may cause many uninfested beans to rot and may impart an objectionable odor to the entire shipment.

Field Experiments with Insecticides

The results of experiments conducted at Yauco and Isabela, the latter in cooperation with the Insular Experiment Station, showed conclusively that dusts containing 80 percent of natural cryolite or 80 percent of potassium fluoaluminate, applied twice to bush beans at the rate of 25 pounds per acre, were very effective in controlling the pod borers. The first application was made when many blossoms and small pods were present, and the second when most of the pods were full-grown but still green. The infestation in plats treated with either of these materials was reduced by more than 90 percent. Similar applications of pyrethrum dust containing 0.9 percent of pyrethrins were moderately effective, but the cost of the material was prohibitive. Two 25-pound-per-acre ap-

plications of derris dust containing 1 percent of rotenone were only slightly effective, whereas two 160-gallon applications of a spray containing sufficient derris powder to provide 0.025 percent of rotenone were moderately effective. Two applications, each at the rate of 25 pounds per acre, of a dust containing 80 percent of magnesium arsenate were approximately 50 percent effective.

The residue from the magnesium arsenate was too dangerous to humans or livestock to permit the use of this material on parts of the plants to be sent to market or used as feed. Since magnesium arsenate, to be effective against the pod borers, must be applied after the pods have formed, this material cannot be recommended as a control. The residues remaining on plants treated with the fluoaluminates are also objectionable, and until more information is available concering the effect of such residues upon man and livestock these materials should not be applied to plants after any part of the plant has formed that will be sent to market or consumed.

The incomplete results of an experiment conducted at Mayagüez in cooperation with the Federal Experiment Station provided no evidence that seven weekly applications of spray containing sufficient derris to provide 0.048 percent of rotenone would be more than slightly effective against the pod borers. The sprays were applied to pole lima beans at the rate of 500 gallons per acre. The addition of fish oil, alkylphenylbenzenesulfonic acid, or coconut-oil soap did not increase the effectiveness of the rotenone. A derris-nicotine sulfate spray containing 0.048 percent of rotenone, 0.09 percent of 40-percent nicotine sulfate, and 0.52 percent of 40-percent coconut-oil soap was no more effective against the eggs and larvae than a spray containing only the 0.048 percent of rotenone. Seven applications of a spray containing 0.23 percent of a commercially prepared aliphatic thyocyanate had no apparent effect on the eggs or larvae of the pod borers.

Varietal Tests

It has already been noted that the most common *Crotalaria* in Puerto Rico, *C. incana,* was almost invariably infested by larvae of the pod borers, the infestation often reaching 100 percent. *C.*

retusa, another common species, was at no time found infested, and reports of other workers (1) (2) indicate that this species is never attacked by pod borers. The reason for this is not entirely clear, since the pods of the two species are in many ways similar. The pods of *C. incana*, however, are somewhat smaller than those of *C. retusa* and much more hairy, whereas the pods of the latter are decidedly more brittle and crisp than the leathery pods of the former.

The decided preference of the borers for the hairy pods of *C. incana* suggested that the pods of certain types or varieties of lima beans might be more susceptible to pod borer attack than those of other types or varieties. The wild lima bean (*Phaseolus lunatus*) bears pods which closely resemble the crisp, papery pods of the small-seeded varieties of lima beans, and are somewhat similar to the crisp, hairless pods of *C. retusa*, which have never been found infested. Even when growing in close proximity to infested wild or cultivated plants the pods of the wild lima bean were invariably free from pod borer infestation.

The fact that certain wild legumes were immune or very resistant to pod borer attack suggested the possibility that certain varieties of lima beans might also be resistant, and with this in mind plantings of 17 varieties, each replicated four times, were placed immediately adjacent to a large planting of severely infested Pole Challenger lima beans. The 68 plats, each of which consisted of a 30-foot row, were arranged in four series, and each of the 17 varieties was represented once in each series.

The author left Puerto Rico before complete yield data could be obtained from the plats, but sufficient pods were harvested to indicate that the small-seeded varieties of lima beans were decidedly more resistant to pod borer attack than the large-seeded varieties, as shown in table 1.

TABLE 1

POD BORER INFESTATION IN SEVERAL VARIETIES OF LIMA BEANS. MAYAGUEZ, PUERTO RICO, 1936

Small-seeded varieties	Pods harvested	Pods infested	
	Number	Number	Percent
Pole Varieties			
Carolina	557	5	0.90
Florida Butter Speckled	625	13	2.08
Bush Varieties			
Henderson's Dwarf	127	4	3.15
Jackson's Wonder	145	2	1.38
Wood's Prolific	117	1	0.85
Burpee's Philadelphia	98	1	1.02
McCrea's	46	3	6.52
Totals and averages	1,715	29	1.69

Large-seeded varieties	Pods harvested	Pods infested	
	Number	Number	Percent
Pole Varieties			
King of the Garden	266	19	7.14
Long Green Seeded	177	13	7.34
Large Early Jersey	201	11	5.47
Burpee's Giant Podded	258	13	5.04
•Sunnybrook	68	1	1.47
Early Leviathan	243	16	6.58
Burpee's Best	158	11	6.96
Bush Varieties			
Burpee's	21	0	0.00
Fordhook	76	3	3.95
Improved	28	0	0.00
Totals and averages	1,496	87	5.82

It was unfortunate that time did not permit the taking of complete yield data from the several plats. The pole varieties produced pods several days earlier than the bush varieties, and it was therefore possible to harvest comparatively large numbers of pods from the former. The information obtained from observations of the small numbers of pods harvested was in no way conclusive, yet it did indicate that the small-seeded varieties were dicidedly more resistant to pod borer attack than the large-seeded varieties. The variety Carolina appeared to be particularly resistant, the 557 harvested pods being only 0.9 percent infested. Florida Butter Speckled, which is very similar to Carolina, also appeared to be at least moderately resistant. The small-seeded bush varieties appeared to be moderately resistant, but since these varieties produced marketable pods several days later than the small-seeded pole varieties, it was impossible to obtain sufficient mature pods to provide more than indicative information. With the exception of the variety Sunnybrook, which produced only 68 mature pods, all the large-seeded pole varieties appeared to be less resistant to attack than the small-seeded pole varieties. The large-seeded bush varieties had not produced sufficient pods upon which to base even indicative conclusions. It is known, however, that all the common large-seeded bush varieties are very susceptible to pod borer attack in Puerto Rico.

Summary

Three species of pod borers, *Maruca testulalis* (Geyer), *Etiella zinckenella* (Treitschke), and *Fundella cistipennis* (Dyar), were found commonly in 1935-36 infesting wild and cultivated leguminous plants in all parts of Puerto Rico. *E. zinckenella* and *M. testulalis* were about equally numerous, but the latter, because it confined its attacks almost entirely to cultivated plants, was by far the most important economically of the two. *F. cistipennis* was the least abundant of the three species, and although it was found largely in cultivated plants, it was much less destructive than either of the other species.

In addition to various legume crops the insects attacked several wild legumes, particularly *Crotalaria incana* L., one of the Island's commonest *Crotalarias*, and *Canavalia maritima* (Aubl.) Thou.,

commonly called the bay been. Some wild legumes, such as the wild lima bean (*Phaseolus lunatus* L.), and one of the commonest *Crotalarias*, (*C. retusa* L.), appeared to be highly resistant, if not inmune, to attack.

The pod borers deposit their eggs on or near the blossoms and blossom buds, thereby assuring ample food for the newly hatched larvae. Most of the injured blossoms drop to the ground, and it is not uncommon to find hundreds of them on the ground under bean plants.

Experiments conducted at Yauco, Isabela, and Mayagüez indicated that the pod borers could be successfully controlled by two 25-pound-per-acre applications of dust containing 80 percent of natural cryolite. Similar applications of pyrethrum dust were moderately effective, but the cost of the material was prohibitive. Dusts and sprays containing rotenone failed to provide satisfactory control.

Observation of various varieties and types of lime beans indicated that the small-seeded lima bean, particularly the variety Carolina, was highly resistant to pod borer attack.

Literature Cited

1. **Wolcott, George N.** The Lima Bean Pod-borer Caterpillars of Puerto Rico. Jour. Dept. Agric. Puerto Rico. 17 (3) : 241-255. 1933.

2. ____________ Lima Bean Pod-borer Caterpillars of Puerto Rico on their Wild Hosts. Jour. Agric. Univ. Puerto Rico. 18 (3) : 429-434. 1934.

3. **Leonard, M. D., and A. S. Mills.** A Preliminary Report on the Lima Bean Pod-borer and other Legume Pod-borers in Puerto Rico. Jour. Eco. Ent. 24 (2) : 466-473. 1931.

A SURVEY OF THE PINEAPPLE MEALYBUG IN PUERTO RICO AND PRELIMINARY STUDIES OF ITS CONTROL

by *H. K. Plank*[1] and *M. R. Smith*, Associate Entomologists, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture[2, 3]

INTRODUCTION

The mealybug has reduced island income from pineapples.

While the growing of pineapples is well distributed in Puerto Rico, commercial plantings are confined chiefly to five main districts where the areas under cultivation total over 2,500 acres. These districts lie mostly in the municipalities of Bayamón, Corozal, Cidra, and Arecibo in the interior and on the north coast, and of Lajas on the southwest coast. The pineapple crop has been a chief source of agricultural income in most of these districts and has returned in previous years about $1,750,000 annually for the island as a whole. It is generally believed that the mealybug, *Pseudococcus brevipes* (Ckll.), has been responsible for decreasing this return and for causing the reduction or abandonment of some formerly high-producing areas.

Survey revealed many ants associated with a high and well-distributed mealybug infestation.

From March to July, 1936, the writers made a brief survey of the occurrence of the mealybug and of the ants associated with it in four of the above-mentioned districts. Since then additional observations were continued to include the range of host plants throughout the island. Preliminary studies were also begun on some of the methods by which pineapple shoots, or "slips", used in planting could be cleaned of mealybugs. The survey revealed a well-distributed, rather high infestation of the mealybug and an

1. Now Associate Entomologist, Puerto Rico Experiment Station of the United States Department of Agriculture.

2. The work here reported was carried on in cooperation with the Puerto Rico Experiment Station of the United States Department of Agriculture at Mayagüez, with special funds available to the Department for studies of insects in Puerto Rico.

3. The writers were assisted in the survey by A. S. Mason, formerly Associate Horticulturist, Puerto Rico Experiment Station of the United States Department of Agriculture.

active association of a large number of species of ants; the control studies indicated that by subjecting the slips to vapor heat for varying periods, an economical and effective method of cleaning planting stock of mealybugs might be evolved.

Because of the importance of the information obtained, it seems desirable at this time to summarize in the present paper the results of the survey and of other observations and to record the work done on control.

Survey of Infestation

Pineapple plants were examined in cross rows as well as on the edges of the fields.

The Bayamón-Corozal district can be considered the center of the pineapple industry of the island. In April, six well-scattered fields of young plants of the Red Spanish variety, representative of the district as a whole, were examined in the municipalities of Toa Baja, Bayamón, and Corozal. Practically all the fields examined were planted in July 1935, and the majority were on sandy clay in more or less hilly country, such as that shown in figure 1.

Fig. 1. View of part of a large pineapple plantation near Corozal, showing type of land devoted to pineapples in most of this district.

In making inspections for mealybugs and ant attendants the method was to select and examine plants spaced approximately 10 steps apart in a typical row running across the fields; in addition the end plant of every other row on the edge of the same fields was also examined. Wherever there was any difference in

surrounding conditions, the plants on the edge adjacent to a turn-row or pasture were selected with the idea of revealing the possible influence of other hosts of the mealybug. In examining the plants, the leaves were bent down and as thorough a search as possible made for the presence of the mealybug and attending ants without actually pulling up the plant or tearing it apart.

Average infestation of 86.3 percent in Red Spanish variety was well distributed.

On the six plantations visited in the Bayamón-Corozal district there was found an infestation of 86.3 percent of a total of 204 plants examined. On two plantations all the plants examined were found infested. The lowest infestation for any plantation was 66.7 percent.

The results for this district showed little difference in percentage of mealybug infestation between the plants in the cross rows and those on the edges of the fields; of these 9-month-old plants, 89.6 percent in the cross rows were infested, as compared with 82.7 percent on the edges. The infestation in the cross rows varied among the plantations from 71.4 to 100 percent, while that on the edges varied from 61.1 to 100 percent. These infestations are relatively high and indicate that infested plants are well distributed and not so concentrated on the edges as has been reported occurring during the early stages of infestation in Hawaiin pineapple fields (6, 2, 3).

The intensity of mealybug infestation was found to be high in many cases. In one field the mealybugs were feeding abundantly on the roots of some plants, while in other fields they were found near the tip of the center leaves. Although no comparative counts were made, the number of mealybugs per plant in most instances seemed to be greater, but perhaps not significantly so, on the edges of the fields than inside.

The elevation on the fields examined in this district varied approximately from 60 to 1,500 feet above sea level, but neither this nor soil type appeared to have any influence on infestation or its intensity.

Intensity of mealybug infestation increased with age of plants.

Practically the same conditions as mentioned above were found in April in two typical fields of the Red Spanish variety on a plan-

tation near Arecibo. These fields were planted in July 1935 in sandy, reddish-brown clay soil of flat topography and medium elevation. Among the 40 plants examined in cross rows, 82.5 percent were infested, as were 85.7 percent of 35 plants on the edges; total infestation, both across and on the edges, 84.0 percent.

At the same time an examination was made in another field at Arecibo which was planted in July 1934, about a year earlier than the fields just mentioned. The plants in this older field were large and the fruits approaching maturity. Among 25 plants examined in a row across this field 76.0 percent were found infested by the mealybug, while of 25 plants on the edge of the same field 92.0 percent were found infested. The total infestation was 84.0 percent, the same as in the young fields just mentioned.

The intensity of the infestation in the young fields at Arecibo seemed to be about the same as in those examined in the Bayamón-Corozal district, with very little difference between cross rows and edges. However, as might be expected, the intensity of infestation in the older field at Arecibo was much higher; a number of plants were found supporting much larger colonies of mealybugs, and many more such plants were located on the edge than inside of the field.

Infestation in "Cabezona" variety was high.

In March, a field of the Cabezona variety was examined on a plantation near Lajas. This field, of slight elevation, contained plants of various ages from recent replants to those in bearing, or approximately 2 years of age. The soil was a rather exhausted, red clay loam. Here every other plant was examined in alternate rows until 4 plants had been inspected in each of 5 rows, a total of 20 plants, in each of the 4 corners and the center of the field. All the plants thus examined in the center and in two diagonally opposite corners were infested by the pineapple mealybug, as were 90 and 95 percent, respectively, of the plants in the other two corners. Considering all the plants in the corners as outside plants, there were 96.3 percent of these infested as against 100 percent in the center of the field; again little difference. The average total infestation was 97 percent. The majority of the plants, especially the older ones, were so heavily attacked by the mealybug that

they had a decidedly wilted appearance. While adverse growing conditions may have been partly the cause of this, there was a strong probability that the mealybug was mainly responsible.

At the same time, a small patch of pineapples grown for home use was examined on another property a little farther south of Lajas. While a number of varieties and ages were represented, most of the plants were of the Pan de azúcar variety and about 8 months old. Of 10 plants examined at random in the center of 10 rows, 70.0 percent were found infested by the mealybug, while of 20 on the 2 ends of the field 75.0 percent were infested; total infestation 73.3 percent. In the absence of actual counts, the intensity of infestation appeared to be at least as high as in most young fields examined in other parts of the island.

Character of Injury and Importance

Mealybug-infested plants were stunted, chlorotic, and wilted and harbored many ants.

The young plants found injured in the Bayamón-Corozal and Arecibo districts were stunted and had narrower leaves than those

Fig. 2. Two pineapple plants of the Red Spanish variety photographed at 9 months of age; the one on the left is uninfested and that on the right heavily infested with the pineapple mealybug attended by ants. Note the stunted condition and narrow leaves of the infested plant, characteristic of injury caused by this association of pests.

usually present on normal plants of the same age. One such plant is illustrated at the right in figure 2. The leaves had an unhealthy, yellow-green color and here and there irregular, slightly chlorotic blotches. Wherever infested plants were found, considerable soil was generally seen piled up in the axils of the leaves by attending ants, as shown in figure 3. Some growers said that this factor alone

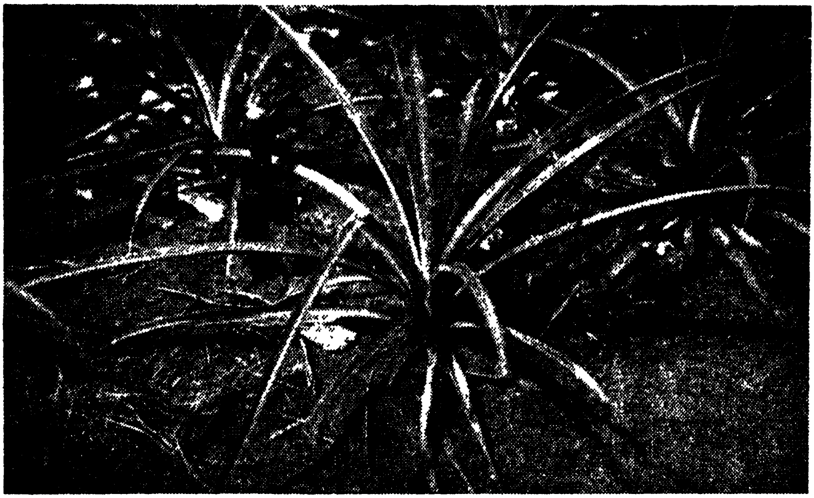

Fig. 3. Close-up of a 9-month-old Red Spanish pineapple plant infested with the pineapple mealybug, showing nest made at base and soil placed over mealybugs in axils of lower leaves by fire ants.

is sufficient to interfere seriously with normal growth, as sometimes occurs when soil is lodged in the leaf axils by wind or careless cultivation.

As the plants grow older, the above injury becomes intensified, the leaves grow still more pronouncedly chlorotic and narrow, and in general the plant assumes a sickly, dusty appearance, suggestive of the symptoms of pineapple wilt as described by writers on this disease in Hawaii (6, 4). The infested old plants of the Cabezona variety examined in the Lajas district distinctly showed this type of injury. While not actually observed by the writers, they were informed that a small experimental planting of the Smooth Cayenne variety made in Puerto Rico some years ago was particularly affected by mealybug infestation and that the plants soon became wilted and died.

Fruits are attacked and their size, quality, and yield seriously reduced.

The mealybug at times infests the flowers, stalk, and fruit, so that some mature fruits will be gnarly and have fibrous flesh with mealybugs sealed in the eyes. A. S. Mason, who has made observations on the pineapple mealybug for a number of years as an agricultural economist, stated that severe infestations have caused production to fall from 175 to 225 crates per acre from a former normal production of 275 to 350 crates per acre, or an average loss of about 36 percent. In the case of salable fruits, he found those from heavily infested fields to average 36 per crate, while such fruits from fields that were commercially free from mealybug infestation were larger and averaged 28.5 per crate. The writers were told by experienced growers that the intensity of mealybug infestation found in the young plants examined in the present survey was sufficient to cause losses approximating the above.

According to many growers, both the extent and the intensity of mealybug infestation have been increasing gradually during the last 6 or 8 years and are now threatening the profitable growing of pineapples in many places in Puerto Rico. It was stated by some that the mealybug was largely responsible for the so-called failure of new land after 3 or 4 years. Ordinary methods of plantation management have yielded unsatisfactory results. The use of clean seed and the spraying of infested fields, as practiced at the present time, are also said to have produced generally poor and costly control. From the present survey the problem of ant control appears to be involved as much as, or more than, that of the mealybug, since ants are an important factor in the dissemination of mealybugs from many host plants to and throughout a field, as well as in interfering with normal pineapple growth and production through lodging soil in the axils of the leaves.

Host Plants of the Pineapple Mealybug

Pineapple mealybug occurred most abundantly in commercial plantings.

The pineapple mealybug doubtlessly occurs on pineapples in every section of the island where this plant is grown, regardless of

variety or whether the plantings are for commercial or for home use. Mealybugs have, however, been found most abundantly in commercial plantings, both with regard to the number of pineapple plants infested and the number of individuals per plant. Judging from examinations made in fields that have been plowed up and in refuse that has been removed therefrom, old pineapple stumps and the chance shoots growing from them will serve as hosts of the mealybug for many months after being uprooted. A pile of such discarded stumps, still heavily infested with mealybugs, is shown in figure 4. While making the above survey and in con-

Fig. 4. Discarded pineapple stumps still heavily infested with mealybugs 6 months after having been plowed up and piled on edge of an old pineapple field. Such crop remnants furnish a dangerous source of infestation to new plantings.

tinuing observations elsewhere since then, the writers found 18 additional species of plants that were infested by this insect. A list of these plants is given in table 1.

TABLE 1

ADDITIONAL HOST PLANTS OF THE PINEAPPLE MEALYBUG FOUND IN PUERTO RICO 1936-38[1]

Host plant		Locality	Habitat	Attendant ants
Scientific name	Common names			
Acanthorrhiza Warscewiczii	Escoba, or broom palm	Mayagüez	About ¼ mile from nearest pineapple plant	*Solenopsis geminata* (F.)
Andropogon virgatus	Rabo de ratón, or rat-tail grass	do.	Roadside, edge of pasture	Do
Apium graveolens	Apio, or celery	do.	Garden on Las Mesas not far from pineapples	None
Bambusa vulgaris	Bambú, or common bamboo	do.	Near old pineapple beds	*Tetramorium* sp.
Cynodon dactylon	Yerba Bermuda, or Bermuda grass	do.	Clay bank far from pineapples	None
Do.	do.	do.	Old pineapple field	*Solenopsis geminata* (F.)
Do.	do.	Juana Díaz	Edge of stream bed	Do.
Cyperus rotundus	Coquí, or nutgrass	Mayaguez	Old pineapple field	Do.
Echinochloa colonum	Arroz del monte, or jungle rice	do.	Roadside, 400 yards from infested pineapple field	Do.
Echinochloa crus-galli	Arrocillo, or barnyard grass	Mayagüez	Roadside, 400 yards from infested pineapple field	Do.
Eleusine indica	Pata de gallina, or goosegrass	Arecibo	Old pineapple field	None
Do.	do	Mayagüez	Dooryard	*Pheidole megacephala* (F.)
Ipomoea Batatas	Batata, or sweetpotato	Bayamón	Edge of infested pineapple field about 1¼ mile from nearest pineapple plant	*Solenopsis geminata* (F.)
Neomammillaria nivosa	Cactus de la Mona, or snow cactus	Mayaguez	In propagation yard, transplanted 1 month from Mona Island	Do. Do.
Panicum purpurascens	Malojillo, or Pará grass	Arecibo	Old pineapple field, and vegetable garden about 40 feet from pineapple plants	*Solenopsis* sp.
Do.	do	Mayaguez	Roadside near old pineapple field	*Solenopsis geminata* (F.)
Panicum sp.	A grass	Arecibo	Old pineapple field	Do.
Do.	do.	Mayagüez	Roadside	Do.
Paspalum conjugatum	Cintillo, or sour parpalum	Arecibo	Edge of infested pineapple field	None
Pectis sp.	Probably yerba de San Juan, or St. John's grass	Mayagüez	Old pineapple field	None
Persea americana	Aguacate, or avocado	Vega Baja	Nursery plats	*Pheidole subarmata* var. *borinquenensis* Whlr.
Vernonia cinerea	Tapacamino, or long shoot	Mayagüez	Old pineapple field	*Solenopsis geminata* (F.)
Zea mays	Maíz dulce, or sweet corn	do.	Garden on Las Mesas not far from pineapples	Do.

1 Most of these plants were determined by Claud L. Horn, Associate Horticulturist, Puerto Rico Experiment Station of the United States Department of Agriculture, from specimens collected by the writers.

Grasses growing in many habitats harbored the pineapple mealybug.

Pará grass, *Panicum purpurascens*, seemed to be one of the grasses preferred by the mealybug around Mayagüez and Arecibo. On this grass, which is common in the island, were found many pineapple mealybugs, and these were invariably attended by strong colonies of the fire ant, *Solenopsis geminata* (F.). In figure 5 is shown a group of several kinds of grasses growing some distance

Fig. 5. Group of several kinds of grasses harboring the pineapple mealybug on edge of a field several hundred yards from where pineapples had been grown some months previously. In such habitats as this, ants are able to become well colonized and, by actively fostering the mealybug, later transfer it to the newly planted field.

from an old pineapple field. Most of the plants in this particular group were found infested with the mealybug.

Twenty-five host plants have been recorded for the pineapple mealybug in Puerto Rico.

Besides pineapple and nutgrass, Wolcott (11) lists the following plants as hosts of this insect: *Saccharum officinarum*, "young

bud coming out from roots of sugarcane"; *Musa sapientum,* "banana rootlets"; *Ficus laevigata,* "aerial roots of jaguey, attended by hormiguilla", *Myrmelachista ambigua* subsp. *ramulorum* Whlr.; *Punica Granatum,* "pomegranate"; and *Tamarindus indica,* "tamarind". Fife (5) recorded the pineapple mealybug on cultivated cotton. So far as the writers can find, this makes a total of 25 host plants that have been recorded for the pineapple mealybug in Puerto Rico.

The data here presented show that the pineapple mealybug has many other host plants than pineapple, that certain grasses and weeds growing in a pineapple field or near the edges of the field can harbor the mealybug and be reservoirs of infestation, and that even plants far removed from a pineapple field act as hosts for this pest.

Ant Associates

Of the 16 species of ants found associated with the pineapple mealybug, 3 were seen carrying this insect.

Examinations of pineapple fields in the localities already referred to revealed 16 species of ants to be definitely associated with the pineapple mealybug in Puerto Rico. Collections of ants were made from the pineapple plants that were infested with mealybugs, and the different species of ants found are arranged in table 2 according to the percentage of times each was noted.

In 13.6 percent of the instances in which ants were seen in the survey there were more than one species of ants found attending mealybugs on the same pineapple plant. In only one field were ants found on less than 50 percent of the mealybug-infested plants; in most cases the percentage was considerably higher, the highest being 92.9 percent. In rows running across the fields ants were seen attending mealybugs on 63.2 percent of the infested plants, in the rows on the edges of the same fields 81 percent. These figures indicate a definite association between the ants and the mealybug; they also indicate a definite relation of the surrounding vegetation to the ant distribution within the field itself, since this vegetation was without cultivation and much of it consisted of hosts of the mealybug or other honeydew producing insects. Three species of

ants were often actually seen carrying healthy-looking mealybugs in their mouths; these ants were *Solenopsis geminata, Brachymyrmex heeri* var. *obscurior*, and *Prenolepis* (*Nylanderia*) sp. probably *fulva.*

TABLE 2

SPECIES OF ANTS DEFINITELY ASSOCIATED WITH THE PINEAPPLE MEALYBUG IN PUERTO RICO, WITH PERCENTAGE OF OCCURRENCE WITH MEALYBUGS ON PINEAPPLE PLANTS[1]

Rank	Species	Occurrence with mealybugs on pineapple plants
		Percent
1	*Solenopsis geminata* (F.)	43.3
2	*Brachymyrmex heeri* var. *obscurior* Forel	36.2
3	*Monomorium floricola* (Jerd.)	11.6
4	*Solenopsis* sp.	6.5
5	*Wasmannia auropunctata* (Rog.)	2.7
6	*Paratrechina longicornis* (Latr.)	2.7
7	*Paratrechina* (*Nylanderia*) *fulva* (Mayr)	2.4
8	*Tapinoma melanocephalum* (F.)	2.0
9	*Crematogaster steinheili* Forel	1.7
10	*Pheidole subarmata* var. *borinquenensis* Whlr.	1.4
11	*Cardiocondyla emeryi* Forel	1.0
12	*Brachymyrmex heeri* Forel	.7
13	*Monomorium carbonarium* subsp. *ebeninum* Forel	.7
14	*Paratrechina* (*Nylanderia*) sp.	.7
15	*Pheidole megacephala* (F.)	[2] .0
16	*Tetramorium* sp.	[3] .0

1 Many of these species have previously been reported by the junior author (10).
2 Found associated with the pineapple mealybug on goosegrass.
3 Found attending the pineapple mealybug on bamboo.

In both the Bayamón-Corozal and Arecibo pineapple-growing districts the fire ant, *Solenopsis geminata,* and the ant, *Brachymyrmex heeri* var. *obscurior,* were the only species commonly found attending the mealybug, whereas in the drier, Lajas area, in the southwest corner of the island, 13 species were found, the ant, *Monomorium floricola,* being first in frequency and the fire ant second.

Pheidole megacephala, the most common ant associated with the

pineapple mealybug in Hawaii (2), was also found attending the pineapple mealybug in Puerto Rico, not on pineapple, however, but on a single plant of goosegrass that was growing in a dooryard in Mayagüez. Although this ant is not native to Puerto Rico, it is apparently well established in several towns, but has not yet been recorded in the rural areas or in the pineapple-growing sections of the island.

The crazy ant, *Paratrechina longicornis*, although of little importance as compared with other species, is a honeydew-loving species and has been definitely found associated with this pineapple pest. *Tapinoma melanocephalum*, a common ant and one that will attend honeydew-excreting insects when the opportunity offers, has not yet been found in sufficient abundance in the pineapple fields to be a great factor in the association complex.

The fire ant was of greatest economic importance.

The first four species of ants given in table 2 appeared at the time of making the survey to be of sufficient abundance to warrant serious consideration as ants that primarily attend the pineapple mealybug. Two of these, the fire ant, *Solenopsis geminata*, and *Brachymyrmex heeri* var. *obscurior*, were widely enough distributed in the pineapple fields and occurred in large enough numbers to be considered of economic significance. However, the fire ant is by far the most important species associated with the mealybug in Puerto Rico. It occurs in large numbers in every field that was examined; its colonies are larger than those of any of the other species found associated with the pineapple mealybug; and, being of an omnivorous nature, this ant is not entirely dependent on honeydew as some of the other species are. The fire ant thrives in open, sunny habitats such as those offered by pineapple fields. It is aggressive and vicious, and its nests are of the compound type, that is, made up of many scattered but component parts. A typical nest made by this ant in grass land near a pineapple field is shown in figure 6.

Fig. 6. Typical nest of the fire ant, *Solenopsis geminata* (F.), in grass land near where pineapples had previously been grown. Note the loose soil with numerous openings into the nest. Ants from this nest were found attending the pineapple mealybug and other scale insects on several grasses in this area. The honeydew excreted by all these insects enables this and other important ants to maintain their colonies at the highest point of activity and later to disseminate the mealybug throughout nearby pineapple plantings.

It is therefore the opinion of the writers that the main fight against ants as disseminators of mealybugs in Puerto Rico will

TABLE 3

NESTING AND FEEDING HABITS AND GENERAL SIZE OF COLONIES OF THE SPECIES OF ANTS FOUND ASSOCIATED WITH THE PINEAPPLE MEALYBUG IN PUERTO RICO

Species	Nesting habits	Type of food and feeding habits	Size of colonies
Brachymyrmex heeri Forel	Soil and wood	Honeydew, predacious	Small.
Brachymyrmex heeri var. *obscurior* Forel	Soil or wood	Honeydew-loving primarily, predacious also	--do.
Cardiocondyla emeryi Forel	Only soil, apparently	Predacious, but also slightly honeydew-loving	--do.
Crematogaster steinheili Forel	Wood or in plants	Honeydew, predacious	Medium.
Monomorium carbonarium subsp. *cheninum* Forel	Soil and wood	Honeydew, predacious	Small.
Monomorium floricola (Jerd.)	Only in wood, apparently	Honeydew, predacious	Medium.
Paratrechina longicornis (Latr.)	Soil and wood	Honeydew, predacious	--do.
Pheidole megacephala (F.)	Soil	Honeydew, predacious	Large.
Pheidole subarmata var. *borinquenensis* Whlr.	Soil and perhaps wood	Honeydew, predacious	Small.
Paratrechina (*Nylanderia*) *fulva* ? (Mayr)	Soil	Honeydew, predacious	Probably small.
Paratrechina (*Nylanderia*) sp.	Soil and wood	Honeydew, predacious	Small.
Solenopsis geminata (F.)	In ground, usually in open sunny areas	Omnivorous, but especially noted for its honeydew-loving and predacious habits	Large.
Solenopsis sp.	In soil and perhaps wood	Honeydew, predacious	Small.
Tapinoma melanocephalum (F.)	Soil and wood	Honeydew, predacious	Medium.
Tetramorium sp.	----------	----------	----------
Wasmannia auropunctata (Rog.)	In soil and wood	Honeydew, predacious	Large.

have to be directed largely against the fire ant. Another species, *Brachymyrmex obscurior*, a small ant that feeds principally on honeydew, should also be included because of its abundance. Fortunately this ant is not aggressive or omnivorous; its colonies are small, consisting usually of only a few hundred individuals, and not widely scattered in the soil.

Honeydew is one of the main foods of the ant associates of the pineapple mealybug.

Table 3 is inserted here to elucidate facts bearing on the general habits and biology of the ants found attending the pineapple mealybug in Puerto Rico. A study of the general nesting habits, type of food, and size of the colonies of the species given in this table will furnish much information regarding the potentialities of these insects as fosterers and disseminators of the mealybug.

While all the ants listed in the foregoing table have predacious habits, the principal food of nearly all of them is honeydew. Many are noted for their habit of propagating and protecting the source of this food. In this class are the fire ant and the other species discussed in the preceding paragraphs.

Plants that harbor honeydew-excreting insects provide food for ants that disseminate the pineapple mealybug.

If plants that harbor other honeydew-excreting insects than *Pseudococcus brevipes* are allowed to grow in a pineapple field or on the edges, these plants will furnish a source of abundant honeydew food to the ants that are ordinarily associated with the pineapple mealybug and thus tend to make these ants more difficult to control or eradicate. Two good illustrations of how this might react against good plantation management were noted in the survey. In a field not far removed from an old pineapple planting, a soft scale, *Aclerda sacchari* Teague, was found colonized on the stems and roots of two grasses. An abundance of fire ants had not only built earthen coverings over some of the scales on the stems but were also busily attending the scales around the roots. On another plantation, fire ants from strong colonies were found

attending mealybugs of the genus *Trionymus* on the roots of goosegrass, *Eleusine indica*, and stems of malojilla, *Eriochloa punctata*. Obviously, plants harboring such honeydew-producing insects will permit colonies of this ant and others that attend the pineapple mealybug to maintain themselves at full strength and thus to thrive on and disseminate the mealybug in nearby new plantings.

Natural Enemies

Three species of small larvae may be possible predators.

While making the examinations detailed earlier in this report, a number of flesh-colored caterpillars about one-fourth inch long were frequently found in the waxy secretion around large groups of old mealybugs in the axils of pineapple leaves. Many of the mealybugs were dead, but, although the caterpillars may have been acting as scavengers feeding on the wax and other accumulated organic matter, it is possible that they may have been preying on the mealybugs. Some moths reared from these caterpillars were determined in the Bureau of Entomology and Plant Quarantine by August Busck as a species of *Tinea* and others by Carl Heinrich as a species of the pyralid genus *Genopaschia*, probably *protomis* Dyar.

A few small, light-pink maggots were also found associated with the pineapple mealybug in the same situations as described above. While not actually seen attacking the mealybugs, it is thought that they were responsible for the death of at least a small percentage. The flies reared from these maggots were determined by C. T. Greene of the Bureau of Entomology and Plant Quarantine as a species of the family Cecidomyiidae belonging to a genus near to *Neolasioptera*. These three species of insects appear to be the only ones that have been reared from and that might be considered as natural enemies of the pineapple mealybug occurring at the time of this writing in Puerto Rico.

One recently introduced parasite has become established.

Through the cooperation of the Bureau of Entomology and Plant Quarantine and the Puerto Rico Experiment Station of the United States Department of Agriculture, two hymenopterous parasites, *Anagyrus coccidivorus* Dozier and *Hambletonia pseudococcina*

Compere, were introduced from Brazil and Hawaii during 1936 and 1937. By extensive rearings and liberations, K. A. Bartlett, who has had charge of the colonization of these parasites in Puerto Rico, succeeded in establishing *Hambletonia* in pineapple fields near Lajas and Arecibo, but has been unable as yet to recover *Anagyrus* at any of the places where it was liberated (1).

Until these or other introduced natural enemies are able to bring about adequate control, it would seem advisable to investigate the other means by which pineapple mealybug injury might be reduced.

Control Studies

With so many ants potentially able to disseminate the pineapple mealybug throughout new plantings and so few natural enemies to reduce its numbers, one of the most important steps in the control of this pest is the use of clean planting material. In the control studies that were undertaken emphasis was therefore placed on some of the methods by which the seed might be readily cleaned of mealybugs. At the same time data were collected on the effect of ants on the mealybug infestation in recently planted pineapples.

Methods of freeing planting slips of mealybugs were tested.

Several lots of approximately 100 commercial planting slips each were given separate treatments in an orientation experiment designed to indicate the effects of these treatments on both the mealybugs and the slips. The slips, all of the Cabezona variety, were heavily infested with *Pseudococcus brevipes*. All lots were homogenized by dealing the slips out in successive rotation into piles from the container in which received.

Because of the success obtained in the control of similar insects by submersion in water (9), two of the experimental treatments were of this nature. In one such treatment the slips were held submerged for a period of 72 hours and in another for 96 hours. After the slips had been packed in 50-gallon iron drums and held down with coarse wire cloth, the drums were filled with tap water to cover the slips completely. The slips were thus held without change of water to the end of above respective periods.

Another treatment involved the use of vapor heat as employed in Hawaii by McBride (8). In this treatment the slips were subjected to moisture-laden air heated to a temperature of about 46° C., approximately 115° F., for a period of 6 hours in a vapor-heat room that had been used in the sterilization of fruit (7).

The relative humidity of the air circulated in the room was maintained with slight variation at about the saturation point. A thermometer, the bulb of which was stuck into a pineapple slip near the center of the sack containing them, was used to record the inside temperature of the slips. A sling psychrometer was used to measure the humidity of the air in the room. These instruments were read by entering the room every half hour throughout most of the treatment.

It took 5½ hours to raise the inside temperature of the pineapple slips to 46.5° C. The fact that the room had to be entered to read the thermometers, which each time caused the temperature to drop about 2 degrees, undoubtedly operated to prolong this approach period. During the subsequent 6 hours of treatment the inside temperature ranged between 46.5° C. and 47° C. most of the time.

After treatment, slips were planted in sterilized soil and guarded from ants.

Immediately or the next day following treatment, each of the three foregoing lots of treated slips and a fourth lot containing untreated slips free from ants were planted in groups of three or four slips each in 10-inch pots, the upper 2 inches of which were filled with soil from a pineapple field. As each slip was planted, a thin section of the base was cut off with a sharp knife to reach fresh tissue and a few of the lowest leaves were stripped off to expose about one-fourth to one-half inch of root zone. In this operation some mealybugs were dislodged and lost, but probably not to the extent as would occur in commercial practice. In order to avoid any contaminating infestation, the soil used for planting had been previously sterilized in the pots by exposure to steam-heated air in the vapor heat room to kill any mealybugs that may have been present. The pots of sterilized soil were then held on ant-guarded tables until used.

After being planted, each of the four lots of slips was kept separate from the other on ant-guarded tables in order to prevent any natural spread of mealybugs from one lot to another, or possible reinfestation by means of ants. When the plants needed moisture they were sprinkled with tap water. The plants were held under these conditions for about 6 weeks to allow any deleterious effects of the treatment on the plants to become evident. This also allowed time for any young mealybugs remaining alive after treatment to develop so they could be easily counted, but not sufficient time for older living stages to reproduce and interfere with the accuracy of the final counts.

Beginning 43 days after treatment, the slips in all lots were dissected. The number of female mealybugs found still alive on the living slips were recorded together with the number of plants that had died to date of examination. These data and the percentage of living slips infested, the percentage of slips dead, and the average number of living female mealybugs found per infested slip are given in table 4. In the last column of this table is also given the percentage of mealybugs killed by each treatment. This was calculated according to the usual formula after bringing the living population in each lot of slips to the same level.

It will be noted in table 4 that the highest kill of mealybugs, 99.13 percent, the lowest infestation, 4.4 percent, and the lowest average number of living mealybugs per infested slip, 1.0, were obtained by keeping the slips submerged in water for 96 hours; but this treatment caused over half of the slips to die. Reducing the time in water to 72 hours resulted in 92.04 percent kill of the insects and 8 percent infestation among the slips, but the infested slips still contained an average of five living mealybugs each, and 15.5 percent of the slips later died.

It will also be noted in table 4 that practically the same percentage of mealybugs, 97.93 percent, was killed on the slips treated with vapor-heat at 46° C. for 6 hours, as on the slips that were kept submerged in water for 96 hours. Moreover, aside from a little scalding noted on the tip and edges of some of the outside leaves on about one-fifth of the plants, none of the slips were adversely affected by the treatment. This slight injury was still

TABLE 4

RESULTS OF THREE TREATMENTS TO FREE CABEZONA PINEAPPLE SLIPS OF THE PINEAPPLE MEALY-BUG. TREATMENTS APPLIED MAYAGUEZ, PUERTO RICO, JULY 6-9; SLIPS EXAMINED AUGUST 21 TO SEPTEMBER 3, 1936

Treatment	Pineapple slips					Living female mealybugs		
	Total treated	Living found infested after treatment		Dead after treatment		Total	Avg. per infested slip	Killed
	Number	Number	Per cent	Number	Per cent	Number	Number	Per cent
Submersion in water for 72 hours	103	7	8.0	16	15.5	35	5.0	92.04
Submersion in water for 96 hours	102	2	4.4	57	55.9	2	1.0	99.13
Vapor-heat at 46°C. for 6 hours	105	11	10.5	0	0.0	11	1.0	97.93
Untreated check	61	44	72.1	0	0.0	308	7.0	0.00

noticeable at the end of a month, but in the meantime it had been largely outgrown, as the plants made good growth and, when compared with the untreated plants, seemed to have been stimulated somewhat by the vapor-heat treatment. Similar stimulation was reported by McBride (8).

As shown in the last line in table 4, 72.1 percent of the slips in the untreated lot were found infested, the average infestation was seven mealybugs per slip, and no slips died during the interval between planting and examination.

Presence of ants increased percentage of mealybug infestation.

In discussing the foregoing treatments it was mentioned that, in order to eliminate the factor of unnatural spread of mealybugs, ants were prevented from having access to any of the treated or untreated lots of slips. Opportunity was taken of this arrangement to obtain data on how much the ants might have increased the percentage of mealybug infestation had they not been kept from reaching the plants.

For this purpose an additional lot of slips that had been homogenized with the above untreated lot was set out in pots on another table from which the ants were not excluded. There were thus provided for observation two sets of pineapple plants, both originally bearing the same percentage of mealybug infestation, ants being kept from one set but not from the other. The results of the examination of the unguarded slips, made about 1½ months after planting, are compared in table 5 with the infestation found after the same interval on the slips that had been kept free from ants.

As shown in table 5, 72.1 percent of the slips that were guarded from ants were found infested with an average of 7.0 mealybugs each, while 83.1 percent of the unguarded slips held an average of 5.9 mealybugs each. The difference in the percentage of slips infested in the two lots was found to be statistically significant.

When the above slips were examined, several colonies of the ant species, *Tapinoma melanocephalum,* were found established in some of the infested plants in the unguarded lot, and a few individual workers of *Monomorium floricola* were also seen attending

TABLE 5

COMPARISON OF MEALYBUG INFESTATION IN PINEAPPLE SLIPS GUARDED FROM ANTS WITH THAT IN SIMILAR SLIPS NOT SO GUARDED. SLIPS PLANTED IN POTS OF STERILIZED SOIL JULY 10-14 AND EXAMINED AUGUST 29 TO SEPTEMBER 3, 1936.

Treatment	Pineapple slips			Living female mealybugs	
	Total	Infested		Total	Average per infested slip
	Number	Number	Per cent	Number	Number
Guarded from ants	61	44	72.1	308	7.0
Not guarded from ants	101	84	83.1	499	5.9

the mealybugs on some of these plants. It is evident that these ants, and possibly others not seen at the time of examination, increased the dissemination of the mealybugs throughout the unguarded slips and thus caused a higher percentage of infestation in them than otherwise would have occurred. In Hawaii it is generally considered that mealybugs will eventually disappear from pineapple plants where ants are not present to attend them (6, 2). The significantly lower infestation in the slips from which the ants were excluded indicates that control of ants might be helpful in preventing rapid dissemination of the mealybug in pineapple fields.

Suggestions for Control

It was evident during the foregoing work that much could be done towards the control of the pineapple mealybug by correcting faulty cultural practices, or by substituting in their place other easily adapted practices that tend to make conditions unfavorable for this pest. An effective system of plantation management necessarily takes into account the presence of host plants other than pineapple and the habits of attendant ants in carrying the mealybug from infested plants to the pineapples. Obviously, clean cultivation in and around pineapple fields will tend to reduce this spread.

Since most of the other hosts of the mealybug are grasses and colonies of attendant ants have a better opportunity for development in uncultivated land, it would be well to avoid planting pineapples on land that has lain in sod for some time or has been without previous frequent cultivation to kill out mealybug host plants and destroy ant colonies.

In preparing fields that have already been in pineapples, much early infestation in the new field can be prevented if all mealybug host plants are destroyed well in advance of replanting. Since old pineapple stumps and plants are the chief source of this early infestation, it would be well to remove and destroy such crop refuse immediately after the last crop has been harvested and not allow it to remain on or near any land that is to be used, even in the near future, for pineapples. The fertilizing value of these old

stumps is more than counterbalanced by the fact that for a long time they will serve to keep ant colonies active and to be a source from which mealybug infestation will spread to the succeeding crop.

After the land has thus been cleaned of pineapple plants and plowed or disked to rid it of other vegetation, and then allowed to settle for a few days, the ant colonies can then be easily located and treated with some soil fumigant to destroy as many ants as possible. Such treatment was carried out with good results in a small area by one large plantation manager, who reported that it could be made practicable on a large scale.

Rather than allow the field to remain fallow and go back to weeds and grasses after this treatment, the planting of a soil-improving crop, such as a legume, that does not harbor the mealybug of other honeydew-excreting insects, or at least is only partially susceptible to them, will tend to keep the land free of both ants and mealybugs until it is ready to plant. So far, the Crotalarias, already widely used in some districts, have proved valuable in this respect, and there may be other plants that will eventually be found to serve the same purpose. To insure best results, however, such crops must be seeded heavily so as to make a dense, shady stand and thus prevent the growth of grasses and weeds, or possible escaped pineapple plants, that harbor the mealybug. This will also tend to keep out such light-and-heat-loving species as the fire ant.

The use of clean seed, or planting slips, is of primary importance in keeping down early mealybug infestation in the new crop. The control experiments with seed treatments here reported have indicated results that warrant further investigation.

Summary

A field survey of conditions in four main pineapple-growing districts of Puerto Rico revealed a mealybug infestation of 87.1 percent among pineapple plants ranging from 9 months to about 2 years of age. The infestation in individual fields varied from 66.7 to 100 percent of the plants examined, and about as many

plants were found infested with the mealybug on the inside of the fields as along the edges.

All parts of the pineapple plant were seen infested, roots, leaves, and fruits, as well as the stem.

Wherever heavily infested plants were found they were usually stunted, chlorotic, and often wilted, and the fruits were much reduced in size. Under conditions of severe infestation the normal yield has been estimated to be reduced by 36 percent.

Including the pineapple, 25 species of host plants of the mealybug have been recorded in Puerto Rico. Evidence obtained showed that the mealybug was widely distributed in the parts of the island where examinations were made, and that certain grasses and weeds in a pineapple field or near the edges can harbor the mealybug and act as reservoirs from which the pineapples will later be infested.

The pineapple mealybug was seldom found unattended by ants. Sixteen species of ants were found associated with this insect, all but two of these being observed attending the mealybug on pineapple plants. The fire ant, the most important species, was found in this association on over 43 percent of the infested plants on which ants were present.

Three species of ants were frequently seen carrying young mealybugs about in the fields.

The greater frequency with which ants were found attending mealybugs on pineapple plants on the edges of the fields as compared with that on the inside, indicated a definite relation of the surrounding vegetation to the ant distribution within the field itself.

That ants do spread the mealybug from infested to uninfested plants was shown experimentally.

The larvae of two small moths, one a tineid and the other a pyralid, and the larvae of a small cecidomyiid fly, all found living in large groups of mealybugs, were thought to be predators of this pest. Two hymenopterous parasites have been recently introduced, but only one has as yet become established in pineapple fields of the island.

In experiments with methods to clean planting stock of mealybugs, submersion of pineapple slips in water for 96 hours under the conditions described resulted in a 99.13 percent kill of the mealybugs but also killed over half the plants. Submersion for 72 hours produced 92.04 percent control but so injured 15.5 percent of the plants that they later died, and among those that survived an average of five living mealybugs were found on each infested slip.

Treating the slips in a closed room with moisture-saturated air at 46° C., about 115° F., for 6 hours seemed to produce the most satisfactory results. 97.93 percent of the mealybug were killed by this treatment, and although 10.5 percent of the slips still contained living mealybugs, the number averaged only one mealybug per slip. None of the planting stock was lost, and instead of injuring the slips this treatment seemed to stimulate their later growth.

The avoidance of sod land for new fields; the removal of mealybug host plants, especially old pineapple stumps, and cover-cropping before replanting old fields; the destruction of ant colonies; the use of mealybug-free seed; and clean subsequent cultivation are given as suggestions for control.

Literature Cited

1. **Barlett, Kenneth A.** Introduction and colonization of two parasites of the pineapple mealybug. Jour. Agr. Univ. Puerto Rico 23 (2): 67-72. 1939.

2. **Carter, Walter.** Studies of population of *Pseudococcus brevipes* (Ckl.) occurring on pineapple plants. Ecology 13: 296-304. 1932.

3. ---------------Border plantings as guard rows in pineapple mealybug control. Jour. Econ. Ent. 25: 1027-1030. 1932.

4. --------------- The pineapple mealybug, *Pseudococcus brevipes*, and wilt of pineapples. Phytopath 23: 207-242. 1933.

5. **Fife, Courtney L.** Insects and mite found on cotton in Puerto Rico, with notes on their economic importance and natural enemies. Puerto Rico Exp. Sta. U. S. D. A., Bul. 39, 9 p. 1939.

6. **Illingworth, J. E.** Preliminary report on evidence that mealybugs are an important factor in pineapple wilt. Jour. Econ. Ent. 24: 877-889. 1931.

7. **Latta, Randall.** The vapor-heat treatment as applied to the control of narcissus pests. Jour. Econ. Ent. 25: 1020-1026. 1932.

8. **McBride, O. C.** Effect of heat on the pineapple mealybug *(Pseudococcus brevipes)*. (Unpublished report). 1932.

9. **Plank, H. K.** Exploratory treatments to clean sugarcane seed pieces of stalk mealybugs. (Unpublished report). 1928.

10. **Smith, M. R.** The Ants of Puerto Rico. Jour. Agr. Univ. Puerto Rico 20: 819-875. 1936.

11. **Wolcott, George N.** "Insectae Borinquenses". A revised annotated check-list of the insects of Puerto Rico, with a host-plant index by José I. Otero. Jour. Agr. Univ. Puerto Rico 20 (1): 123. 1936.

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THE BIOLOGY OF THE TROPICAL CATTLE TICK AND OTHER SPECIES OF TICK IN PUERTO RICO, WITH NOTES ON THE EFFECTS ON TICKS OF ARSENICAL DIPS[1]

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INTRODUCTION

For many years the presence of the tropical cattle tick, *Boophilus annulatus microplus* (Can.) (*australis* Fuller), in Puerto Rico has been a serious impediment to the development of the cattle industry in that island. In addition to heavy losses occasioned by tick infestation alone, the rôle of these ectoparasites in the transmission of tick fever of cattle has resulted in enormous losses and has presented an obstacle to the introduction of the better breeds of non-immune stock from tick-free areas.

This tick is a variety of the common cattle tick, *Boophilus annulatus* Say, which occurred throughout the southern portions of the United States prior to the initiation of eradication work.

Both these varieties are single-host ticks; *i.e.*, they remain on the same animal for their entire period of development from larvae, or seed ticks, to engorged females, after which they drop to the ground, seek protection, and soon begin to deposit eggs. The host relationships, habits, developmental periods, and longevity of this tropical variety in the United States have been shown by Hooker, Bishopp, and Wood (2) to be similar to those of the cattle tick, *Boophilus annulatus*.

[1] Headquarters for these studies were located at the Puerto Rico Agricultural Experiment Station, Mayaguez, P. R., from the beginning of the studies through November 1937; and at the School of Tropical Medicine, San Juan, P. R., from December 1937 until the termination of the work in the summer of 1938. At each of these institutions various facilities, including office and laboratory space, were furnished. The writer acknowledges his indebtedness to Wilbur McPherson and S. H. Still of the Bureau of Animal Industry, United States Department of Agriculture, who were in charge of cattle tick eradication in Puerto Rico, for their assistance in obtaining materials and equipment and for their cooperation in various other ways.

The facts that both these varieties prefer cattle as the host and do not commonly attack the various species of wild animals, and that *Boophilus annulatus* has been largely eradicated from the United States, indicated the feasibility of eradicating the tropical variety from Puerto Rico. During the year 1936 plans were made by the Bureau of Animal Industry, United States Department of Agriculture, in cooperation with the Puerto Rico Reconstruction Administration and the Insular Department of Agriculture, to conduct an eradication campaign in Puerto Rico. Since successful eradication obviously must be based on an accurate knowledge of the biology of the tick concerned, and under the conditions involved, it was decided that a study should be made of the biology of the tick in Puerto Rico.

The investigations which form the basis of this report were begun during the latter part of 1936 and completed during the summer of 1938. The technical phases of the problem were under the general supervision of F. C. Bishopp, In Charge of the Division of Insects Affecting Man and Animals, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, in cooperation with the Federal Experiment Station, Mayaguez, P. R. These investigations were first carried on with funds available to the Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture for studies on insects of Puerto Rico. From December 1937 to the termination of the work the project was carried on with funds allotted to the Bureau of Animal Industry by the Puerto Rico Reconstruction Administration.

ECONOMIC IMPORTANCE

The tropical cattle tick will attach itself to practically any part of the body of its host, but it usually occurs in greatest abundance about the head and ears, flanks, and escutcheon. At the points of heavy concentration there is considerable irritation, frequently resulting in cracking and sloughing of the skin. Heavily infested animals lose condition and become listless and emaciated, a condition frequently referred to as tick anemia, which predisposes them to other more acute diseases. Among dairy animals there is a marked decrease in milk production. Occasionally cattle, especially young animals, die as a result of gross tick infestation.

Of perhaps greater importance than the tick infestation itself is the fact that these ectoparasites are the natural agents of dissemination of splenetic or tick fever of cattle. Not only has this disease caused heavy losses through the death of many animals and through loss of condition and lowered vitality of many others, but it has also greatly retarded the

improvement of native stock, particularly dairy animals, because of the reluctance to import purebred stock from tick-free areas. The eradication of the tick, with the resulting elimination of tick fever and an increased production of milk and butter, undoubtedly would contribute greatly toward a more extended use of dairy products by the poorer classes of Puerto Rico, who now can afford only a little of such food.

GEOGRAPHICAL DISTRIBUTION

The tropical cattle tick is widely distributed throughout the West Indies and over practically the entire area of South and Central America. In some parts of Mexico it is recorded as a serious pest. In the United States it was well established in several counties in Florida and over a smaller area in Texas previous to the tick-eradication work of the United States Department of Agriculture, which has reduced the infested area to the extreme southern portions of Texas and Florida. From these records it is apparent that this variety is distributed throughout the tropical and sub-tropical parts of the Western Hemisphere. It has become established also in Borneo, Sumatra and the Philippine Islands.

NON-PARASITIC DEVELOPMENT

Method of Study

The method followed in determining the preoviposition period, incubation period of the eggs, and possible larval life was essentially that described by Hooker, Bishopp, and Wood (2). For confining the ticks, bottomless glass tubes 1½ inches in diameter and 8 inches in length were used. About 2 inches of sand and clay was packed in one end of the tubes, and they were then set in sandy, well-drained soil with the soil level in the tube even with the ground surface. The top of each tube was then covered over with a piece of muslin held in position by a strong cord. To prevent any disturbance of the tubes they were surrounded by a fence of one-half-inch mesh, and the top of the enclosure was covered over with burlap as a protection against downpours of rain. In this way the ticks were partially exposed to the rain but largely protected from the direct rays of the sun. This prevented the condensation of moisture within the tubes, except during the most humid weather in areas of comparatively high rainfall. Observations could be made readily through the glass tubes without disturbing the ticks.

The circumstances under which these tests were conducted are considered to represent closely optimum natural conditions for development

TABLE 1. PREOVIPOSITION, INCUBATION, AND LARVAL LONGEVITY OF *BOOPHILUS ANNULATUS MICROPLUS* IN OUTDOOR CAGE AT MAYAGUEZ, PUERTO RICO

CAGE A—THE SOIL SURROUNDING TUBES MOISTENED BY RAIN ONLY

Date females collected from host	Preoviposition period	Minimum incubation period	Larval longevity
1936	*Days*	*Days*	*Days*
December 17	4	34	115
December 26	6	39	106
1937			
January 14	6	40	105
January 30	4	39	120
February 13	5	32	120
March 1	3	31	116
March 15	4	30	113
March 30	3	30	113
April 14	3	27	115
April 29	4	25	122
May 14	3	28	103
June 1	2	27	129
June 16	4	25	111
July 14	3	28	109
July 29	3	28	107
August 12	2	28	119
September 16	2	29	130
October 5	3	28	141
October 15	3	26	133
November 3	2	30	145
November 16	2	33	138

CAGE B—THE SOIL SURROUNDING TUBES KEPT MOIST BY ADDITION OF WATER

Date females collected from host	Preoviposition period	Minimum incubation period	Larval longevity
1937	*Days*	*Days*	*Days*
January 14	6	40	112
January 30	4	38	121
February 13	5	34	128
March 1	3	33	118
March 15	3	33	112
March 30	4	31	120
April 14	3	31	113
April 29	4	27	113
May 14	3	30	103
June 1	2	29	109
June 16	4	30	115
July 14	3	28	109
July 29	3	28	130
August 12	2	28	125
September 4	2	27	144
September 16	2	29	144
October 5	3	28	133
October 15	3	26	138
November 3	2	30	142
November 16	2	33	140
December 11	2	33	154
1938			
January 12	2	38	145

and longevity of the non-parasitic stages (eggs and larval) when the ticks are not on hosts.

All records of the non-parasitic stages herein reported were obtained under outdoor conditions. Tests were conducted in three climatically

different areas, Maricao, Santa Rita, and Mayaguez. Maricao is fairly typical of the mountainous regions which, generally speaking, include the central portion of the island; Santa Rita is representative of a comparatively small but rather definite area along the dry southern coastal region; and along the remainder of the coastal region climatic conditions more nearly approach those at Mayaguez.

In the series of tests at Mayaguez, two cages were used to hold the tubes, one of which was moistened by rain only and a second to which water was added whenever necessary to maintain it in a continuously moist condition. In this second cage water was needed infrequently, except for brief intervals during the dry season, hence there was little variation in the results obtained in the two cages. In the Santa Rita area the greater portion of the rainfall occurred during the last 6 months of the year and this, as a rule, was in the form of infrequent but heavy downpours. As a result, the soil surrounding the tubes was dry most of the time even during the rainy season.

In each series of longevity tests, each series being represented by a line of data in tables 1-3, 15 engorged females were used, one being placed in each of 5 tubes and 5 females in each of 2 other tubes. The tubes at Mayaguez were examined from 4 to 5 times each week. At Maricao and Santa Rita examinations usually were made at weekly intervals, but more frequently if a previous observation indicated that a marked change, such as hatching, might take place within a period of less

TABLE 2. PREOVIPOSITION, INCUBATION, AND LARVAL LONGEVITY OF *BOOPHILUS ANNULATUS MICROPLUS* IN OUTDOOR CAGE AT SANTA RITA, PUERTO RICO

Date females collected from host	Preoviposition period [1]	Minimum incubation period	Larval longevity
	Days	*Days*	*Days*
1936			
December 17	6	32	75
December 28	4	36	72
1937			
January 14	6	33	90
February 13	5	27	87
March 15	4	21	71
April 14	3	23	72
May 14	3	22	88
June 16	4	18	74
July 14	3	22	66
August 12	2	22	78
September 16	2	22	65
October 15	3	19	78
November 16	2	23	73
December 11	2	26	90
1938			
January 12	2	33	85
February 14	4	28	78

1 These ticks were kept at Mayaguez until oviposition began, hence these preoviposition records do not apply to Santa Rita.

than 1 week. These observations were continued from the time the female were placed in the tubes until the last larva had died. To reduce to a minimum the time and expense involved in traveling, all engorged females used in the tests at Maricao and Santa Rita were first confined in tubes at Mayaguez until oviposition began and then transferred immediately to these other locations.

TABLE 3. PREOVIPOSITION, INCUBATION, AND LARVAL LONGEVITY OF *BOOPHILUS ANNULATUS MICROPLUS* IN OUTDOOR CAGE AT MARICAO, PUERTO RICO

Date females collected from host	Preoviposition period [1]	Minimum incubation period	Larval longevity
	Days	*Days*	*Days*
1936			
December 28	4	76	149
1937			
January 14	6	67	161
February 13	5	71	144
March 15	4	63	184
April 14	3	57	180
May 14	3	52	159
June 16	4	46	173
July 14	3	49	163
August 12	2	47	148
September 16	2	58	179
October 15	3	54	175
November 16	2	66	165
December 11	2	75	158

[1] These ticks were kept at Mayaguez until oviposition began, hence these preoviposition records do not apply to Maricao.

Preoviposition Period

The preoviposition period, which represents the interval between detachment of the female and the beginning of oviposition, ranged from 2 to 6 days (tables 1-4). There was no appreciable difference in the duration of the preoviposition period of partially engorged females and replete females. A smaller number of eggs, however, was deposited by the partially engorged individuals.

Oviposition Period

The oviposition period of individual ticks was not determined because of the unimportance of such records and the time that would have been required to obtain them. Data were obtained, however, on a group of 33 females in the insectary at Mayaguez. Among these the range was from 11 to 18 days. The duration of this period depends on temperature and to some extent on humidity as well as on a number of other factors, such as state of engorgement. Maximum daily egg production was attained a few days after oviposition began, and there was a marked

decline in the rate of deposition during the last week or 10 days. The females died within 5 to 10 days after the total oviposition was completed.

The eggs deposited by each of 10 females that dropped from cattle under natural conditions were counted and the average was found to be 2,257, with a maximum of 3,518 and a minimum of 1,395.

Incubation Period

The duration of the incubation period is dependent largely on temperature, and to some extent on humidity, warm, moist weather being most conducive to speedy hatching. Abnormally dry, hot weather resulted in a partial dehydration of the eggs, after which they did not hatch normally, and prolonged exposure to direct sunlight destroyed their viability.

At Mayaguez the minimum incubation period in individual egg clusters ranged from 25 to 40 days (table 1); at Santa Rita, from 18 to 36 days (table 2); and at Maricao, from 46 to 76 days (table 3). The minimum incubation period was considered as extending from the time the first eggs were deposited until the eggs in the series began to hatch. Although the hatching period ranged from 5 to 8 days, the majority of the eggs hatched within the first 4 or 5 days.

No appreciable variation in the incubation period could be detected among samples of eggs segregated at the beginning of oviposition, near the middle, or toward the termination of this period.

Length of Larval Life

The longevity of the larvae was considered from the standpoint of larvae that did not succeed in attaching to any host and extended from the time at which hatching began until the last larva had died of starvation. The actual time during which the larvae would have been capable of successfully attaching to a host probably would be slightly less than this period.

The length of the possible larval period depends largely on temperature and humidity. During protracted periods of high temperatures and low humidity, the larvae emerge from the eggs in a weakened condition, and also, under such conditions, life is shortened through an accelerated loss of body moisture by evaporation. A high relative humidity prolongs life, apparently by conserving the body fluids and decreasing the activity of the tick.

As shown in table 4, the larval life at Mayaguez ranged from 103 to 154 days, at Santa Rita from 65 to 90 days, and at Maricao from 144 to 184 days.

TABLE 4. SUMMARY OF DATA OBTAINED ON PREOVIPOSITION PERIOD, INCUBATION PERIOD OF EGGS, AND LARVAL LONGEVITY OF *BOOPHILUS ANNULATUS MICROPLUS* AT MAYAGUEZ, MARICAO, AND SANTA RITA, PUERTO RICO

Station	Preoviposition period[1]	Minimum incubation period	Larval longevity	Mean average temperature	Average[2] rainfall	Total[3] rainfall
	Days	*Days*	*Days*	° *F.*	*Inches*	*Inches*
Mayaguez (Cage A)..	2-6	25-40	103-145	76.31	6.46	135.66
Mayaguez (Cage B)..	2-6	26-40	103-154			
Santa Rita...	2-6	18-36	65-90	78.34	1.78	37.40
Maricao	2-6	46-76	144-184	72.53[4]	8.17	171.56

[1] All preoviposition periods were determined at Mayaguez.
[2] Average monthly rainfall for 21 months during which longevity tests were conducted.
[3] Total rainfall for 21-month period.
[4] For May-November 1937 only.

Duration of the Non-parasitic Period

The total possible non-parasitic period is of particular significance in determining the time it is necessary to continue dipping operations to accomplish tick eradication. Although there was little variation in this period from season to season under Puerto Rican conditions, there was a marked variation at different locations on the island, as is shown in tables 1, 2, and 3. At Santa Rita the period from dropping of female to the death of the last larva ranged from 89 to 129 days, or a maximum of approximately 4⅓ months; at Maricao the range was from 197 to 251 days, or a maximum of approximately 8⅕ months; and Mayaguez represented an intermediate zone, the range being from 134 to 189 days, or a maximum of approximately 6¼ months.

Temperature and rainfall records for the three different localities are shown in table 4. Since temperature records for the Maricao area are not available except for the months of May to November 1937, inclusive, the mean average of 72.53° F. is presented merely as an approximation for the entire period.

DEVELOPMENT OF PARASITIC STAGES

Method of Study

For studying the parasitic stages, the experimental animals were placed in stalls, the floors of which were made of concrete. Each stall, or cage, was surrounded by a moat which was kept filled with water to prevent escape of the ticks as well as to prevent their movement from one animal to another. Before each test was begun the stalls were thoroughly washed and then disinfected. To insure that the experimental animals were tick free previous to the beginning of an experiment, they were

dipped in a standard arsenical solution. Immediately afterwards they were placed in the tick-free stalls and kept under observation from 10 days to 2 weeks before being used. Throughout the course of the experiment each type of animal was completely isolated to preclude any possibility of accidental infestation.

A series of infestation experiments were conducted on cattle, horses, goats, sheep, dogs, and hogs. Particular emphasis was placed on observations relative to the time elapsing between larval attachment and dropping of the engorged female. The duration of parasitic development is of great practical importance in tick eradication, since the interval between dippings is based on this period. All the animals of each type were infested simultaneously with from 2,000 to 2,500 larval ticks each. All larvae used in the tests were of vigorous stock, insofar as could be determined, and with a known history and of about the same age. The infested animals were examined daily, and records were made as to the state of development of the ticks and any abnormal host reaction.

Development on Cattle

Five different series of infestation experiments were conducted with cattle. In the first experiment one of the animals used was a young bull of native stock, and the other a young heifer having about one-quarter Zebu (Brahma) blood. Since in the first experiment no ticks completed development on the animal with Zebu blood, a cross between native stock and Guernsey was substituted for succeeding tests, since such animals are more susceptible to tick infestations.

Of the approximately 2,000 larval ticks applied to each animal, only a small proportion successfully attached themselves and developed to the adult stage. The actual numbers of engorged females that dropped from the animals in the five series of tests were 32, 139, 45, 660, and 47, respectively, and the infestation having 139 females is considered as typical and the detailed records are presented in table 5.

Larval stage. When the larvae were placed on an animal they immediately scattered and crawled about excitedly over the host. Within a short time, however, most of them began making attempts to attach themselves. In many cases several attempts were made before a satisfactory location was found. Apparently there was a marked preference on the part of the larvae for certain portions of the body of the host, usually points where the hair coat and skin were thinnest. Soon after the larvae were applied the hosts became considerably irritated and scratched and licked themselves. Undoubtedly a considerable number of

TABLE 5. PARASITIC PERIOD OF *BOOPHILUS ANNULATUS MICROPLUS* ON CATTLE AS FOUND ON TWO INFESTED HOSTS. THE INFESTATION INCLUDED 139 FEMALES. MALES WERE OBSERVED UP TO LAST DAY THAT FEMALES WERE PRESENT

Date (1937)	Remarks
April 26	Larvae placed on cattle.
April 27— 1st day	All remaining larvae attached.
May 5— 9th day	First nymphs observed.
May 7—11th day	All larvae molted.
May 10—14th day	First adult observed.
May 15—19th day	All nymphs molted.
May 16—20th day	11 engorged females dropped.
May 17—21st day	16 engorged females dropped.
May 18—22nd day	43 engorged females dropped.
May 19—23rd day	34 engorged females dropped.
May 20—24th day	14 engorged females dropped.
May 21—25th day	18 engorged females dropped.
May 22—26th day	1 engorged female dropped.
May 23—27th day	2 engorged females dropped.

the larvae were thus removed. In the five series of tests conducted, the larval stage ranged in length from 7 to 12 days.

Nymphal stage. A noticeable circular swelling, ranging from one-third to three-fourths of an inch in diameter, developed around the point of attachment of the nymphs, a condition previously observed by other workers. This reaction disappeared upon completion of the nymphal stage and was not observed to be associated with either the larval or adult stage.

The nymphal stage ranged in length from 5 to 17 days, but most of the nymphs molted by the eighth or ninth day.

Adult stage. The period of parasitization by the adult ranged from 5 to 23 days. A majority of the femals, however, engorged and dropped from the host by about the tenth day. In most cases the males were observed to remain on the host for about the same length of time as the females.

The time elapsing between attachment of the larvae and the dropping of the engorged females ranged from 18 to 37 days, but the greater number of specimens had completed engorgement and dropped by the twenty-fifth day. The length of the entire life cycle may range between 41 and 300 days.

Infestation Experiments on Goats

In the first experiment with goats two mature males were used; in the three succeeding tests two kids, one male and one female, respectively; and in the fifth or last experiment, a male kid.

The larvae attached themselves almost exclusively to the head, neck, and back, except that in the case of male goats they attached in comparatively large numbers to the scrotum. In infestations Nos. 3 and 4 large numbers attached along the back in the long, thin hair where de-

velopment was markedly more rapid than on other parts of the body, with the exception of the scrotum. Those that attached to the ears developed slowly, and the majority of them became detached before development was completed.

In some cases the observations could not be made complete enough to determine accurately the duration of certain stages. The total time of development, however, could be determined with little difficulty. In general, the minimum developmental period of the parasitic stages did not vary markedly from that on cattle. On the other hand, the average maximum was considerably longer.

The numbers of females that completed engorgement and dropped from the host in the 5 series of tests were 18, 2, 49, 55, and 17, respectively. One infestation has been selected as representative and the results are presented in detail in table 6. In the entire series the larval stage ranged from 7 to 18 days, the nymphal stage from 7 to 27 days, the adult stage from 6 to 20 days, and the period from attachment of larvae to dropping of engorged females from 20 to 38 days.

TABLE 6. PARASITIC DEVELOPMENT OF *BOOPHILUS ANNULATUS MICROPLUS* ON GOATS. THE DATA ARE FROM THE INFESTATIONS ON ONE MALE AND ONE FEMALE KID

Date (1937)	Remarks
August 6	Larvae placed on goats.
August 14—8th day	First larvae molted.
August 18—12th day	Last larvae molted
August 21—15th day	First nymph molted
August 28—22nd day	8 engorged females dropped.
August 30—24th day	18 engorged females dropped.
August 31—25th day	5 engorged females dropped
September 1—26th day	10 engorged females dropped.
September 2—27th day	2 engorged females dropped.
September 6—31st day	1 engorged female dropped.
September 7—32nd day	1 engorged female dropped.
September 8—33rd day	3 engorged females dropped
September 13—38th day	1 engorged female dropped.

Infestation Experiments on Sheep

The animals used in the first three tests on sheep consisted of one well-matured male and one young female, each of which was a cross between the wool and the sparsely woolly types of sheep. For the fourth and fifth experiments young wool-type rams were used. With few exceptions the larvae attached to the ears, head, neck, or inguinal region, and, in the case of males, to the scrotum, which was an extremely favorable site for development. In general, attachment occurred in places where there was little or no wool.

In some cases the exact limits of the larval and nymphal stages could not be determined accurately, mainly because of the difficulty of locating the ticks in the long hair. A considerable number of individuals that

attached, particularly in the ears, and developed to the nymphal stage, and in some cases even molted to the adult stage, failed to complete development. In infestation No. 1, 28 replete females dropped from the host. None completed development in infestations Nos. 2 and 5. The reason for this failure was not determined. In the fourth infestation, 480 engorged females developed, 90 percent or more of which were attached to the scrotum. Infestation No. 1 is selected as fairly typical of development on sheep and the detailed records are presented in table 7. In those instances where accurate determinations could be made, the range of the larval stage was found to be from 7 to 12 days, the nymphal stage from 7 to 13 days, and the adult stage from 4 to 24 days. The total parasitic period, concerning which complete records were obtained, ranged from 20 to 37 days.

TABLE 7. PARASITIC DEVELOPMENT OF *BOOPHILUS ANNULATUS MICROPLUS* ON SHEEP. (ONE MALE AND ONE FEMALE HOST ANIMAL)

Date (1937)	Remarks
February 15	Larvae placed on sheep.
February 28—13th day	Partly engorged to engorged nymphs observed.
March 1—14th day	First adults observed.
March 9—22nd day	3 engorged females dropped. Nymphs present.
March 11—24th day	6 engorged females dropped. Nymphs present.
March 12—25th day	6 engorged females dropped. All nymphs molted.
March 13—26th day	2 engorged females dropped.
March 14—27th day	1 engorged female dropped.
March 15—28th day	3 engorged females dropped.
March 17—30th day	2 engorged females dropped.
March 18—31st day	1 engorged female dropped
March 19—32nd day	2 engorged females dropped
March 22—35th day	1 engorged female dropped.
March 24—37th day	1 engorged female dropped.

Infestation Experiments on Horses

In each of the five tests with horses, native animals of the pony type were used; in the first three, a mare and a young colt; in the fourth, an old stallion; and in the fifth, a fairly mature mare. In all cases from 2,000 to 2,500 larvae were placed on each animal, but, with the exception of infestation No. 5, no ticks were found following application of the larvae. The colt used in the first three tests had a light infestation of *Boophilus annulatus microplus*, including all stages, at the time it was purchased; but apparently its susceptibility had been lost, at least temporarily, when the experiments were conducted.

The animal used in infestation No. 5 had a moderately heavy infestation of both *Boophilus annulatus microplus* and *Dermacentor nitens* when procured, but only a few ticks developed as far as the nymphal stage in the experimental infestation with *B. a. microplus* a few weeks later. On the fifth day following the application, large numbers of partly engorged to engorged larvae were observed; on the seventh day,

a few recently molted larvae were noted, and by the tenth day only nymphs were present. Following this there was a rapid decrease in the number of nymphs and none could be found after the fourteenth day. The horse developed a severe case of sarcoptic mange soon after the experiment was begun, which probably influenced the tick infestation.

Infestation Experiments on Dogs

Four series of experiments were conducted with dogs. In the first three, two well-matured animals were used; and in the fourth, one was a mature male and the other a small male puppy. At the points of attachment of the ticks, which did not appear to be confined to any particular region of the body, considerable bleeding occurred, usually terminating in a mildly ulcerating sore. The presence of the ticks evidently caused severe irritation, since the animal reacted by violent scratching and rubbing of the body, which frequently either crushed or detached the parasites.

Although none of the females became completely engorged in the first experiment with dogs, 35 of them became sufficiently engorged to deposit viable eggs. In infestations Nos. 2 and 3 only a small number developed to the nymphal stage, and a still smaller number became adults. Twenty-nine adult females, all of which were on the small male puppy, completed development in infestation No. 4.

The larval and nymphal stages were both found to range in length from 8 to 16 days, the adult stage from 14 to 20 days, and the period following larval attachment to dropping of the engorged females from 22 to 29 days. The 29-day record, however, is not considered as representing the maximum, since the majority of the ticks became detached before engorgement was completed. The records obtained in infestation No. 1 are presented in detail in table 8 as an example of tick development on dogs.

TABLE 8. PARASITIC DEVELOPMENT OF *BOOPHILUS ANNULATUS MICROPLUS* ON TWO DOGS

Date (1937)	Remarks
February 15	Larvae placed on dogs
February 27—12th day	Engorged nymphs observed.
March 4—17th day	Unengorged adult observed.
March 9—22nd day	Nymphs still present.
March 11—24th day	4 females, ⅓ to ½ engorged, dropped. No nymphs observed.
March 12—25th day	10 females, ¼ to ⅓ engorged, dropped.
March 13—26th day	9 females, ¼ to ⅓ engorged, dropped.
March 14—27th day	5 females, ⅓ to ½ engorged, dropped.
March 15—28th day	3 slightly engorged females, dropped.
March 16—29th day	4 females, ¼ to ½ engorged, dropped.

Infestation Experiments on Hogs

The animals used in the four series of experiments with hogs were as follows: In the first and second tests, two young pigs weighing about 20 pounds each; in the third, two pigs weighing about 50 pounds each; and in the fourth, a single animal weighing about 60 pounds. Although a considerable number of larvae attached themselves, usually on or near the base of the ears, and developed for a short time, they began to disappear during the late larval or early nymphal stages. Only a very small proportion developed to the adult stage, and, with the exception of one female, none of these became sufficiently engorged to oviposit. The hogs rubbed themselves against the sides of the pen or other objects and this tended to destroy any ticks on exposed parts of the body, particularly engorged individuals.

The results of one infestation experiment are presented in table 9 as a typical example of development on hogs.

TABLE 9. PARASITIC DEVELOPMENT OF *BOOPHILUS ANNULATUS MICROPLUS* ON A HOG

Date (1937)	Remarks
October 13	Larvae placed on hog.
October 19 -6th day.	About 2 dozen larvae attached near base of ear
October 20- 7th day.	Small proportion of above larvae observed in same position
October 21 to November 9	No ticks observed
November 9- 27th day.	1 female, about three-fourths engorged, attached to shoulder
November 10—28th day.	This female tick crushed.

Miscellaneous Infestation Experiments

In February 1938 approximately 1,000 larval ticks were placed on a white rabbit. Although daily observations were made, no attached ticks were found for the first 12 days following the application. On the thirteenth day one partly engorged nymph was observed on the rabbit's ear. Ten days later the nymph molted but became detached on the fourteenth day following without having completed development.

In conjunction with the above test, about 1,000 larval ticks were placed on each of two chickens (mature hens, native stock). On the following day a small number of unattached larvae were present but none could be located on succeeding days.

HOST RELATIONSHIPS

Cattle are the favorite host of *Boophilus annulatus microplus* but horses, goats, sheep, and other animals are commonly attacked.

To establish the host range of the tropical cattle tick under Puerto Rican conditions, and at the same time to determine the relative impor-

tance of its hosts, various types of animals, both domestic and wild, were carefully examined under natural conditions. Incidentally, the wild mammal fauna in Puerto Rico is confined entirely to the rat, mongoose, and bats. Records were made regarding the stages of ticks present, the presence of females sufficiently engorged to deposit eggs being especially noted. The results of these studies are presented in the following paragraphs and in table 10.

TABLE 10. SUMMARY OF RECORDS OF HOSTS OF *BOOPHILUS ANNULATUS MICROPLUS* EXAMINED IN NATURE

Type of animal	Animals examined	Animals infested	
	Number	*Number*	*Percent*
Goats	375	58	15.5
Sheep	360	82	22.8
Horses	131	16	12.2
Hogs	383	0	0
Dogs	180	2	1.1
Mongooses	15	1*	0
Bats	27	0	0
Rats	5	0	0

* Unengorged and unattached.

Goats

A total of 375 goats of various ages were examined and of these approximately 15 percent were infested with *Boophilus annulatus microplus*. Usually only larvae, nymphs, or unengorged adults were found and in quite a number of instances only a few specimens (5 to 10) were observed. In a small percentage of cases, however, several hundred ticks were taken from a single animal, among which were a considerable number of engorged females.

The sites of attachment were most commonly the head and ears, along the back, between the toes, and in the case of males, the scrotum. Occasionally several hundred larvae, nymphs, and unengorged adults were found attached to the inner folds of the external ear.

Among goats, a higher degree and frequency of infestation was evident on young animals, particularly those only a few weeks old, but in one instance well-engorged ticks were taken from practically all parts of the body of a well-matured female, and in a number of other cases mature animals were found to be quite heavily infested. Occasionally when young animals were found to be heavily infested with ticks of all stages, including well-engorged females, they were kept under observation for several weeks to determine the period of time over which the infestation was maintained. In spite of the fact that some of these animals were kept under such conditions as to offer an excellent opportunity for reinfestation, invariably they became tick free after a few weeks. Two such

animals were purchased for experimental purposes in connection with host tests. In the first test, which was begun soon after the purchase of the animals, only a small proportion of the larval ticks applied attached themselves, and a still smaller proportion completed development. In two succeeding tests, however, these same animals proved to be excellent tick hosts.

There are a considerable number of goats in Puerto Rico, both in the country and in villages, some of which are used for milk production and others for slaughter. The majority of these animals are owned by laborers, who, as a rule, have from one to three or four animals which usually are tied out each day by means of a leash along roadsides, fence rows, ditch-banks, or in other idle areas. Since these animals ordinarily are not allowed to range in pastures with cattle they are not consistently exposed to ticks. The animals live in close association with their owner, as a result of which any large parasites, such as engorged female ticks of *Boophilus annulatus microplus*, are likely to be removed by hand.

A few comparatively large herds of goats, consisting of 15 to 30 animals representing various ages, were located and carefully examined. The frequency of tick infestation among individuals in these herds was found to be much greater than among isolated animals.

Apparently isolated goats, or those occurring in comparatively small groups, do not maintain a tick population for more than a few months, unless cattle are present to furnish a continuous source of reinfestation. On the other hand, it appears quite likely that herds of goats of a dozen individuls or more, in which animals of various ages are present, may maintain a tick population over a period of several months, if not indefinitely.

Sheep

The sheep population in Puerto Rico, as compared to goats, is small, but a majority of them occur in relatively large herds. Of 360 animals examined, 82, or 22.8 percent, were found to be infested with *Boophilus annulatus microplus*. As compared to goats, a somewhat greater proportion were harboring engorged female ticks.

Attachment was almost invariably to those parts of the body free from wool or long hair, such as the ears, head, parts of the neck, and the inguinal region. A considerable portion of the sheep in Puerto Rico are the sparsely wooled type and a mixture of this type with the wool breeds, and the density of wool on sheep in Puerto Rico is considerably less than that which normally occurs on similar breeds in the United States. On such animals the degree and frequency of infestation was much less than

on the wool-type breeds of North America. At Aguirre Central, a herd of 94 wool-type sheep was examined, 64 or 68 percent of which were tick-infested, whereas out of a herd of 55, consisting of the wool and sparsely wooled types mixed, examined on the following day on the property of Guanica Central, only 2 animals, or 3.6 percent, were infested with ticks. Both herds were ranging in pastures with tick-infested cattle under conditions that appeared to be equally favorable for picking up an infestation.

Sheep should be considered an important factor in Puerto Rico in maintaining a population of *Boophilus annulatus microplus.*

Horses

Occasionally single horses were found to be heavily infested with the tropical cattle tick, whereas others equally exposed were tick free. In some instances a single horse among a number of others, all of which were ranging together in a pasture, was found to be heavily infested, whereas no ticks were present on the other animals. The susceptibility of an individual animal, however, appeared to vary markedly from time to time.

Attachment was usually on the breast and neck region, but in cases of heavy infestation ticks were found on various parts of the body, particularly in the mane and tail. Young animals coated with long hair appeared to be especially favorable hosts. On such animals a relatively greater number of engorged females were encountered than on mature animals.

Of 131 horses examined, 16, or 12.2 percent, were found to be infested with *Boophilus annulatus microplus,* and it is concluded that horses, as well as goats and sheep, should be regarded as a potential source of danger in Puerto Rico and should be taken into consideration in a program for eradicating the cattle tick. This is particularly important in the movement of animals from tick-infested areas to tick-free areas.

Other Animals

A total of 383 native hogs, including all ages and from various sections of the island, were examined under natural conditions. In no case were ticks found.

Of 180 dogs examined, *Boophilus annulatus microplus* was found on only 2 animals; in one case a single female tick about one-third engorged and in the other an unengorged nymph. It is evident that under natural conditions in Puerto Rico the occurrence of this tick on dogs is extremely rare and of an accidental or temporary nature. Eighty, 44.4 percent,

of the 180 dogs examined were infested with the brown dog tick (*Rhipicephalus sanguineus* (Latr.)).

No ticks were found on 27 bats, including 2 species, *Artibeus jamaicensis jamaicensis* Leach and *Tadarida numina* (Gray), which were collected from 3 different localities on the island.

The mongoose, which originally was introduced into Puerto Rico as a beneficial predator, is common and widespread. Fifteen of these animals were carefully examined, but no ticks were found, with the exception of one unengorged larva of *Boophilus annulatus microplus.*

A number of mature brown rats collected under somewhat similar circumstances were found to be tick-free.

RESISTANCE TO TICK INFESTATION

It was frequently observed that certain individuals among cattle manifested a marked resistance to infestation by the tropical cattle tick. Among Zebu animals, both pure-bred and crosses, a marked degree of resistance to tick infestation was evident. A variation in susceptibility unquestionably exists in other breeds of cattle. This condition was apparent even to a greater extent among less favorable host species such as horses, goats, sheep, and dogs.

Observations indicated that young animals, particularly among horses, goats, and sheep, were more susceptible to tick attack than older animals. Specific cases were noted in which young animals carrying a heavy tick infestation gradually became tick-free even though conditions were extremely favorable for a continuous reinfestation. It would seem that in some cases repeated attacks of ticks tended to produce immunity or increased resistance.

Somewhat similar host reactions were observed in connection with dogs infested with *Rhipicephalus sanguineus.*

OTHER TICKS OCCURRING IN PUERTO RICO

In Puerto Rico three species of ticks commonly occur, namely, the tropical cattle tick (*Boophilus annulatus micriplus*), the tropical horse tick (*Dermacentor nitens*), and the brown dog tick (*Rhipicephalus sanguineus*). To the writer's knowledge, two other species have been collected on the island, but apparently neither has become well established up to the present time. The iguana tick (*Amblyomma dissimile* Koch) was taken from toads (*Bufo marinus L.*) in Puerto Rico in 1935 by Francisco Sein of the Insular Experiment Station. During a conversation with the writer, Mr. Sein stated that the ticks were taken from toads

that had been imported to the island a short time previously. Although a considerable number of toads were examined in Puerto Rico during the course of the present work, no ticks were found. The writer collected a species of tick, *Amblyomma cruciferum Neumann*, from an iguana lizard (*Cyclura stegnegeri* Barbour and Noble) which recently had been introduced from Mona Island.

The Tropical Horse Tick

Of 131 horses from various parts of the island, which were examined, 75, or 57.2 percent, were infested with *Dermacentor nitens*. This tick was found in greatest abundance on horses in the mountainous regions where rainfall is comparatively heavy. In such areas the majority of the horses are small animals, and, as a rule, they are in rather poor physical condition. Heavy infestations of *D. nitens* rarely were encountered on well-kept horses.

In cases of light or moderate infestations attachment was confined largely to the ears, the anal region, and the inguinal region, but in heavy infestations the ticks often were attached to practically any part of the body. On one occasion a laborer was observed scraping ticks from a horse with a machete.

The tropical horse tick occurs on goats and sheep to about the same extent as does the tropical cattle tick on these animals. It is more commonly found, however, within the ears. *Dermacentor nitens* was not taken on cattle by the writer.

Notes on life cycle of Dermacentor nitens. *Dermacentor nitens* is a one-host tick: that is, it spends its entire parasitic life on the same animal. Although the writer conducted no life-history studies, he noted that at Mayaguez the preoviposition period covered from 3 to 5 days and the incubation period from 21 to 28 days.

Dunn (1), who made some observations on the life history of *Dermacentor nitens* in Panama, presented records concerning the longevity of the non-parasitic stages as follows: Preoviposition period from 5 to 7 days, and incubation period from 25 to 27 days. During the course of these observations the temperature range was from approximately 71° to 94° F., which corresponds rather closely with the temperature range in Puerto Rico.

Hooker, Bishopp, and Wood (2) summarized the development of the parasitic stages, which were studied at Dallas, Tex., as follows: "The larvae are short lived, living only 71 days in summer under the most favorable conditions; they engorge and molt on the host as soon as 8 days after attachment. Nymphs may molt as soon as the seventeenth day

after attachment or 7 days after the larvae molt. Adults may engorge and drop as soon as 9 days after the nymphal molt or 26 days after attachment as larvae."

From the foregoing notes it is evident that the life cycle of *Dermacentor nitens* is similar to that of *Boophilus annulatus microplus.*

The Brown Dog Tick

A considerable proportion of the dogs in Puerto Rico are more or less continuously infested with the brown dog tick (*Rhipicephalus sanguineus*). The severity of an infestation of a given animal varies considerably from time to time, largely depending on prevailing climatic conditions, particularly rainfall. At Mayaguez the population of the brown dog tick was comparatively low during the dry season, the specimens encountered more commonly being unengorged adults. At times there was found to be as much as 90 percent parasitization of the tick by the hymenopterous parasite *Hunterellus hookeri* How., which undoubtedly plays an important part in the control of this tick.

Rhipicephalus sanguineus is a particularly serious pest among well-kept dogs, or animals having a restricted range; whereas among stray dogs, which were numerous in Puerto Rico, this pest occurs much less frequently. The writer did not take *R. sanguineus* from any animals in Puerto Rico other than the dog, with the exception of a small number of immature stages observed on young domesticated rabbits which were being kept in close contact with tick-infested dogs. In cases where infested dogs are allowed to remain to some extent in dwelling houses, ticks often may be observed crawling about over the floors, walls, and furniture, and on rare occasions they attach themselves to man.

PARASITES OF TICKS

During the study of tick incidence on various hosts, engorged nymphs of *Boophilus annulatus microplus* and *Rhipicephalus sanguineus* were collected for the purpose of determining if parasites of these were present. The nymphs were collected from animals on various parts of the island, placed on moist sand in the insectary at Mayaguez, and kept under observation for approximately 1 month. An attempt was made to collect nymphs of *B. a. microplus* in the vicinity of areas where parasites of *R. sanguineus* were known to occur.

Of 23 collections, including 1,000 specimens of engorged nymphs of *Boophilus annulatus microplus,* none were found to be parasitized. Among 15 collections of *Rhipicephalus sanguineus,* the percentage of

parasitization ranged from 0 to 94.1. Of a total of 574 engorged nymphs collected, 232, or 40.4 percent, were parasitized. Samples of the parasites were submitted to the Bureau of Entomology and Plant Quarantine for identification and all were found to be *Hunterellus hookeri.*

The number of parasites emerging from an engorged nymph ranged from 4 to 10, the usual number being, however, from 7 to 10. As a rule emergence of the parasites occurred from 2 to 3 weeks after collection of the engorged nymphs.

No parasites emerged from any of several collections of *Dermacentor nitens* made in the vicinity of Mayaguez.

EFFICACY OF THE STANDARD ARSENICAL DIP IN THE DESTRUCTION OF BOOPHILUS ANNULATUS MICROPLUS IN PUERTO RICO

The experimental animals were dipped in a standard arsenical dip[2] diluted to a strength of 0.18 to 0.19 percent arsenious oxide. The criterion for determining the efficacy of the dip was to collect engorged female ticks from cattle at intervals after dipping and place them under conditions favorable for oviposition and incubation of the eggs. The females were kept under observation until they died and, in case oviposition occurred, the eggs were kept until the viability was determined.

As a rule engorged females removed from animals within a short time after a dipping either failed to oviposit or, if they did so, only a small proportion, if any, of the eggs hatched. In some instances, particularly in the case of heavily infested animals, ticks, including engorged females, were still present after the animal had been dipped the second time. With rare exceptions, however, the animals were free of ticks following the third dipping.

In one experiment female ticks that had been removed from animals 8 days after a dipping produced approximately a normal number of viable eggs, whereas females removed previous to this time produced few if any eggs, practically none of which hatched. In another case four females removed at the end of 72 hours after a dipping deposited about a normal number of eggs, the majority of which were viable. The reason for this apparent discrepancy was not determined, but quite probably these particular individuals had not come in full contact with the dip solution.

Athough in one series of tests a few females which were removed from the host up to the fifty-second hour after a dipping oviposited, none

2 The arsenical dip solution used was a commercial one which met the specifications of the Bureau of Animal Industry of the United States Department of Agriculture.

of the eggs hatched. After this no engorged females were present, but live unengorged ticks were observed on the animal on the third and fourth days.

It is generally supposed that nymphs that are in the process of molting at the time of dipping are protected from the solution to some extent by the presence of the old skin. Although this is merely an assumption, it has been offered by other workers as a possible explanation for the presence of live ticks after a dipping.

In practically all cases ticks that were discovered maturing on animals after a dipping were in locations comparatively well protected by a long coat of hair. This observation is in accord with that of Legg (3) in Australia.

EFFICACY OF ARSENICAL DIP IN THE DESTRUCTION OF DERMACENTOR NITENS

Since horses are a potential source of breeding of *Boophilus annulatus microplus,* it was considered advisable to dip them at 14-day intervals along with cattle. As previously stated, a considerable proportion of the horses in Puerto Rico are infested with the tropical horse tick (*Dermacentor nitens*). In view of the fact that *D. nitens* has a life cycle somewhat similar to that of *B. a. microplus,* it seemed logical to suppose that perhaps it could be eradicated in the regular dipping procedure as prescribed for the cattle tick. An attempt was therefore made to determine the effectiveness of the standard arsenical dip in the destruction of this tick.

In certain areas where horses were heavily infested with *Dermacentor nitens,* a number of them were kept under observation over a period of several weeks during the early stages of the systematic dipping operations, and records were made as to the presence of ticks after the treatments. All records and observations indicated that the toxicity of standard arsenical dips for *D. nitens,* when specimens of that species were thoroughly wet with arsenical solution, was practically the same as for *Boophilus annulatus microplus.*

Fifteen engorged females taken from horses within a few minutes after a dipping in a solution testing 0.18 percent arsenious oxide and placed in pill boxes on moist sand died without having oviposited. The same number of females taken from horses under similar circumstances at a later date deposited a small number of eggs, none of which hatched.

Dermacentor nitens normally attaches within the ears, under the tail, and between the hind legs where they have considerable protection from

the solution. The long hair and waxy or oily secretion in the ears of horses often prevented thorough wetting of the inner surface of the external ear. Horses, also, frequently succeeded in holding their heads above water when going through the dipping vats. Occasionally ticks in protected places on other parts of the body failed to come in contact with the dip solution. Because of these circumstances, it was obvious that in order to eradicate *D. nitens* during the course of the regular procedure for the tropical cattle tick it would be necessary to exercise special precautionary measures to insure that the dip solution comes in contact with all ticks in protected places.

SUMMARY

The tropical cattle tick (*Boophilus annulatus microplus* Can.) is of importance not only because of the irritation caused and debilitating effect on the host animal but because it is a natural agent of dissemination of splenetic or tick fever of cattle. It is widely distributed throughout South America, Central America, and Mexico, as well as in the islands of the West Indies and in Borneo, Sumatra, and the Philippine Islands. In the United States, although formerly occurring in several counties in Florida and over a smaller area in Texas it has now been eradicated from all except the extreme southern portions of these two States.

The facts that this variety and the cattle tick (*Boophilus annulatus* Say) do not commonly attack wild animals and that the cattle tick has been largely eradicated from the United States indicated the feasibility of eradicating the tropical variety from Puerto Rico. The biology under Puerto Rican conditions was therefore investigated as a basis for eradication work, and the results of studies in 1936, 1937, and 1938 are given in this paper.

Ticks in their non-parasitic periods were studied in bottomless glass tubes set in the soil, and those in their parasitic periods, as attached to host animals confined in isolated stalls.

The preoviposition period ranged from 2 to 6 days, the oviposition period from 11 to 18 days, and the minimum incubation period, under different climatic conditions, from 18 to 76 days.

There was no marked seasonal variation in larval longevity of *Boophilus annulatus microplus* in Puerto Rico. Larval longevity in the dry southern coastal region and in the higher altitudes of the interior, where there is a comparatively high rainfall, however, ranged from 65 to 184 days; and the total non-parasitic period, or the period from the dropping of the engorged female to the death of the last larva, ranged from 89 to 251 days.

The larvae began to molt from the seventh to the twelfth day after their application to a bovine host. Nymphs completed engorgement 12 to 26 days after attachment, or 5 to 17 days after the larval molt. The period from the nymphal molt to the dropping of the engorged female, or the adult stage, ranged from 5 to 23 days. The minimum period from attachment of the larva to the dropping of the engorged female was 18 days, and the maximum period was 37 days.

The life cycle, including both parasitic and non-parasitic development, may be completed in Puerto Rico on cattle within a minimum period of approximately 41 days; the maximum may extend over a period of approximately 300 days. The minimum parasitic period of *Boophilus annulatus microplus* on goats, sheep, and dogs was found to be practically the same as that on cattle.

The tropical cattle tick was taken from goats, sheep, and horses in considerable numbers under natural conditions. Host records definitely indicate that these animals should be taken into account in a cattle tick eradication campaign in Puerto Rico. In Puerto Rico, dogs, hogs, and mammals other than the above apparently are of little or no importance as natural hosts of the cattle tick.

In addition to *Boophilus annulatus microplus* two other species of ticks commonly occur in Puerto Rico and are of widespread economic importance, *viz.*, the tropical horse tick (*Dermacentor nitens*) and the brown dog tick (*Rhipicephalus sanguineus*).

No parasites of the tropical cattle tick were found. However, a high degree of parasitization by the hymenopterous parasite *Hunterellus hookeri* was encountered among nymphs of the brown dog tick.

Standard arsenical dips, such as are used in the continental United States, proved to be effective in destroying the tropical cattle tick in Puerto Rico, practically all the animals being free of engorged female ticks after the second or third dipping. The arsenical dip was also effective against the tropical horse tick but considerably greater care was necessary in dipping horses to insure that the solution came in contact with all the ticks on the animal.

LITERATURE CITED

1. **Dunn, L. H.** Observations on the Preoviposition, Oviposition and Incubation of *Dermacentor nitens* in Panama (Arach., Acar.) Ent. News **26:** 214-219. 1915.
2. **Hooker, W. A., F. C. Bishopp, and H. P. Wood.** The Life History and Bionomics of Some North American Ticks. U. S. Dept. Agri., Bur. Ent. Bull. **106:** 239, illus. 1912.
3. **Legg, John.** Some Observations on the Life History of the Cattle Tick (*Boophilus australis*). Queensland Roy. Soc. Proc. **61:** 121-132. 1929.

THE INTRODUCTION AND COLONIZATION IN PUERTO RICO OF BENEFICIAL INSECTS PARASITIC ON WEST INDIAN FRUITFLIES

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West Indian fruitflies are well-known pests in Puerto Rico. Two species of West Indian fruitflies (*Anastrepha mombinpraeoptans* Sein and *A. suspensa* (Loew)) are well known in Puerto Rico. The frequency of their occurrence in the fruits of mango (*Mangifera indica* L.), particularly in many of the introduced varieties, in guava (*Psidium guajava* L.), and in jobos (*Spondias* spp.) may be readily noted throughout the island. In addition *A. suspensa* attacks orange and grapefruit (*Citrus* spp.).

The eggs of these two fruitflies are deposited in the flesh of the fruit and here the young larvae hatch and complete their development; when full-fed, the larvae usually emerge and pupate in the soil. During the larval stage the insect is living in the fleshy part of the fruit where it is protected to some extent from attack by parasites. This protection within the fruit is overcome in the case of some parasite species which have long ovipositors and thus are able to probe rather deeply into the fruit in their search for host larvae. Also, some types of fruit such as the jobo are thin fleshed and the fruitfly larvae must by necessity feed close to the outer surface. However, in most other susceptible hosts the fruitfly larvae are not readily accessible to attack by the parasites.

Facilities of the Bureau of Entomology and Plant Quarantine were utilized in the collection of parasites. The introduction of fruitfly parasites was a project undertaken by the Bureau of Entomology and Plant Quarantine in July 1935. Since October 1936 it has been continued as a project of the Puerto Rico Agricultural Experiment Station of the United States Department of Agriculture. The facilities and personnel of the Bureau of Entomology and Plant Quarantine were utilized to assemble parasite material for shipment to Puerto Rico. Such shipments received from Hawaii were assembled by O. C. McBride, from

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Mexico by A. C. Baker, and from Panama by James Zetek. Material was also received from Brazil, where it was collected by D. T. Fullaway, at that time working with the same Bureau. One shipment of parasites was received from West Africa via Moorestown, N. J., and was collected and handled by the personnel of the Bureau. Two shipments introduced from Hawaii were assembled by D. T. Fullaway of the Board of Commissioners of Agriculture and Forestry, Territory of Hawaii.

A considerable period of time has now elapsed since the introduced fruitfly parasites were liberated. While it appears doubtful if any have become established, it seems worthwhile to record the introductions for the sake of any future investigations which might be undertaken. It will be noted that many of the introduced parasite species were known to be parasitic only on the Mediterranean fruitfly (*Ceratatis capitata* (Wied.)), and while others were known to be parasitic on the genus *Anastrepha* they were not parasitic on the same species of *Anastrepha* which are known to occur in Puerto Rico. This may account to some extent for the failure of their establisment on the Puerto Rican species of *Anastrepha*.

Seventeen species of parasites were introduced into Puerto Rico. From September 1935 to May 1936 there were received from Hawaii 11 shipments of fruitfly parasites composed of 5 species,[2] namely, *Opius fletcheri* Silv., *O. humilis* Silv., *O. fullawayi* (Silv.), *O. tryoni* Cam., and *Tetrastichus giffardianus* Silv. In addition shipments of Dirhinus *giffardii* Silv. were received from Hawaii in 1937. All these, parasites of the Mediterranean fruitfly (*Ceratatis capitata* Wied.), had been introduced into Hawaii from various countries of the world to aid in the control of this well-known fruitfly pest.

Seventeen shipments were received from the Canal Zone, consisting of six species, *Ashmeadopria* sp., *Eucoila* sp., *Opius bellus* Gahan, *O. cereus* Gahan, *Pachycrepoideus dubius* Ashm., and *Pseudeucoila brasiliensis* (R. V. Ihr.), all parasites of *Anastrepha* spp.

From Brazil there were received six species, *Eucoila* (*Hexamerocera*) sp., *Ganaspis* sp., *Opius cereus* Gahan, *Opius* sp. near *cereus, Pachycrepoideus dubius*, and one species of diapriid, genus unknown, all parasites of *Anastrepha* spp.

From Mexico 10 shipments of *Opius crawfordi* (Vier.), a parasite of *Anastrepha ludens* (Loew), were sent to Puerto Rico.

One shipment of *Opius perproximus* Silv. was received from West Africa via Moorestown, N. J., through the facilities of the Bureau of

[2] Determinations of all parasite species introduced were made by A. B. Gahan, C. F. Muesebeck, and L. A. Weld of the Bureau of Entomology and Plant Quarantine.

Entomology and Plant Quarantine. A summary of the introductions is found in table 1.

TABLE 1. THE INTRODUCTION INTO PUERTO RICO, DURING 1935-37, OF PARASITES TO AID IN THE CONTROL OF THE WEST INDIAN FRUITFLIES, *ANASTREPHA* SPP., GIVING SPECIES, ORIGIN OF SHIPMENT, NUMBER OF SHIPMENTS, AND NUMBER OF PARASITES RECEIVED ALIVE

Species	Origin of shipments	Number of shipments	Number of parasites received alive
Ashmeadopria sp	Canal Zone	7	100
Dirhinus giffardii	Hawaii	2	78
Diapriids	Brazil	1	15
Eucoila sp	Canal Zone	6	13
Eucoila (*Hexamerocera*) sp.	Brazil	5	16
Ganaspis sp	Brazil	1	2
Opius bellus	Canal Zone	17	522
Opius cereus	Canal Zone	16	66
Opius cereus	Brazil	10	654
Opius crawfordi	Mexico	10	3,509
Opius fletcheri	Hawaii	2	118
Opius fullawayi	Hawaii	4	231
Opius humilis	Hawaii	10	556
Opius perproximus	West Africa	1	30
Opius tryoni	Hawaii	11	3,191
Pachycrepoideus dubius	Brazil	4	20
Pachycrepoideus dubius	Canal Zone	6	105
Pseudeucoila brasiliensis	Canal Zone	10	204
Tetrastichus giffardianus	Hawaii	10	3,728
Total		133	13,158

One shipment of *Opius cereus* originating in Brazil was also transshipped through the facilities of the Bureau of Entomology and Plant Quarantine at Moorestown, N. J.; this shipment also contained specimens of *Opius* sp. near *cereus*, with slightly shorter ovipositor. The number of each species in this shipment was not recorded separately.

The parasites from Hawaii were all introduced species and the native home of each is recorded by Back and Pemberton[3] as follows:

Dirhinus giffardii (West Africa)
Opius fletcheri (India)
O. fullawayi (Africa)
O. humilis (South Africa)
O. tryoni (Australia)
Tetrastichus giffardianus (West Africa)

Some of the introduced parasite species were reared in the laboratory on West Indian fruitflies. All the introduced parasite species were larval parasites, *i.e.*, they attack their host in the larval stage, with the exception of two, *Dirhinus giffardii* and *Pachycrepoideus dubius*, which were pupal parasites. In all species, however, emergence of the adult parasite takes place after the fruitfly puparium has formed. Extensive rearing work was carried on with the two pupal parasites in order to increase the numbers available for liberation. Most of the larval parasites received were exposed in the laboratory to various kinds of

[3] Back, E. A., and Pemberton, C. E. 1917. The Mediterranean Fruitfly in Hawaii. Bull. 536 United States Department of Agriculture, pp. 1-116. Illus.

TABLE 2. THE LIBERATIONS OF FRUITFLY PARASITES IN PUERTO RICO DURING 1935-38 GIVING PARASITE SPECIES, DATE, LOCATION, AND NUMBER LIBERATED

Species	Date of liberation	Municipalities															
		Adjuntas	Añasco	Arecibo	Boqueron	Cabo Rojo	Caguas	Juana Diaz	Lajas	Maricao	Mayaguez	Ponce	Rincon	San-German	Vega Alta	Yauco	Total
		No.	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
Ashmeadopria sp.	June-July 1936	...	...	...	...	...	...	104	...	...	...	...	...	...	...	...	104
Dirhinus giffardii	Aug. 1937-Nov. 1938	...	1,354	...	195	...	897	1,291	1.268	...	2,717	307	457	1,019	...	430	9,935
Diapriids	May 1936	...	...	...	...	...	...	...	...	...	...	15	...	...	...	...	15
Eucoila (Hexamerocera) sp.	May 1936	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	2
Eucoila sp.	June-Sept. 1936	...	...	...	...	...	...	13	...	...	...	...	...	...	...	...	13
Opius bellus	June-Sept. 1936	...	...	...	...	...	...	497	...	...	...	...	...	...	...	...	497
Opius spp.[1]	May 1936	...	...	...	...	...	...	...	...	...	409	...	...	...	...	...	409
Opius cereus[2]	June-Sept. 1936	...	...	...	...	...	...	71	...	...	...	...	...	...	...	...	71
Opius crawfordi	Aug. 1935-Aug. 1936	...	...	...	...	1,289	490	655	...	...	1,023	...	...	...	...	...	3,457
Opius fletcheri	Oct.-Nov. 1935	...	...	...	...	...	...	...	...	...	108	...	...	...	...	...	108
Opius fullawayi	Oct.-Nov. 1935	...	...	77	...	...	...	...	...	...	180	...	...	...	...	...	257
Opius humilis	Sept. 1935-May 1936	...	...	72	...	...	...	...	...	79	306	...	...	...	...	...	457
Opius perproximus	Feb 1936	...	...	...	...	...	...	30	...	...	...	...	...	...	...	...	30
Opius tryoni	Sept. 1935-May 1936	496	...	646	...	303	...	277	...	227	436	...	161	...	536	...	3,082
Pachycrepoideus dubius[3]	June-July 1936	...	...	...	...	...	...	98	...	...	...	...	...	...	...	...	98
Pachycrepoideus dubius	June-July 1936	...	...	...	...	...	...	583	622	...	...	724	...	...	...	...	1,929
Pseudeucoila brasiliensis	June-Aug. 1936	...	...	...	...	...	...	164	...	...	...	...	...	...	...	...	164
Tetrastichus giffardianus	Sept. 1935-May 1936	531	...	700	...	...	...	500	...	318	1,069	...	204	...	399	...	3,721
Total		1,027	1,354	1,495	195	1,592	1,387	4,283	1,890	624	6,248	1,048	822	1,019	935	430	24,349

1 Material received from Brazil. Two species are recorded together; *Opius cereus* and *Opius* sp. near *cereus* with slightly shorter ovipositor.
2 Material received from Canal Zone.
3 Reared material.

fruit infested with West Indian fruitflies in order to determine if the hosts occurring in Puerto Rico were acceptable to them.

Dirhinus giffardii was reared in large numbers in the laboratory on both species of *Anastrepha* and also on the housefly (*Musca domestica* L.) and on the papaya fruitfly (*Toxotrypana curvicauda Gerst.*). Oviposition was readily obtained in freshly formed puparia of all species.

Pachycrepoideus dubius was successfully reared on both species of *Anastrepha,* also on the housefly (*M. domestica*), on the hornfly (*Haematobia irritans* (L.)), and on *Sacrophagula occidua F.* Both these pupal parasites apparently attack a large variety of dipterous puparia.

Opius bellus was successfully reared in the laboratory on *Anastrepha mombinpraeoptans* infesting jobo. It was not tried on other host fruits.

Opius crawfordi was not successfully reared on either species of *Anastrepha.* Infested fruits of jobo and guava were both tried without success. Probing in the fruit was observed, but no parasites ever issued.

Opius humilis was successfully reared on *Anastrepha suspensa* infesting pomarosa but did not successfully oviposit in *A. mombinpraeoptans* infesting mango.

Opius tryoni was successfully reared on *Anastrepha mombinpraeoptans* infested jobo, and a few specimens were reared from *A. mombinpraeoptans* infesting mango.

Oviposition with the various species of *Opius* was obtained by placing infested fruit in a suspended position in cloth cages containing the parasites. The many failures in the case of the fruitfly infesting mango can probably be attributed to the fact that the host larvae were deep in the flesh of the fruit and the parasites were unable to reach them for successful oviposition.

Liberations of fruitfly parasites were made throughout the island. Extensive liberations of the various species of imported parasites were made in 15 different municipalities of the island. A summary of the liberations is found in table 2.

Eight species of native parasites were reared from West Indian fruitflies. Eight species of native parasites were reared in Puerto Rico from the West Indian fruitflies (*Anastrepha mombinpraeoptans* and *A. suspensa*). Table 3 is a summary of the parasite species reared.

The only native parasite which is of any importance in controlling either of these fruit pests is *Opius anastrephae,* which is often found in abundance attacking *Anastrepha mombinpraeoptans* infesting jobo. The other beneficial species are found only occasionally and the percentage of parasitization by these was always less than 1 percent. This variation in parasitization is believed to be largely due to the difference in the types

TABLE 3. INDIGENOUS PARASITES REARED FROM WEST INDIAN FRUITFLIES IN PUERTO RICO, 1935-38

Parasites of *Anastrepha mombinpraeoptans*	Parasites of *Anastrepha suspensa*
Ashmeadopria sp.	*Ashmeadopria* sp.
Eucoila sp.	*Eucoila* sp.
Eucoila (Hexamerocera) sp.	*Eucoila (Hexamerocera)* sp.
Opius anstrephae Vier.	*Ganaspis* sp.
Trichopria sp.	*Opius anastrephae*
	Phaenopria sp.

of fruit infested by the two species of *Anastrepha*. *A. suspensa* is found largely in fleshy fruits whereas the jobo, a favorite host of *A. mombin-preaoptans,* is thin fleshed and the fruitfly larvae, which by necessity feed close to the surface, are readily accessible to attack by parasites. All the native parasites known to be present in Puerto Rico have short ovipositors and are not able to probe deeply into the fruit in search of host larvae.

Shipments of parasites were made to Hawaii and the Dominican Republic. Two shipments of *Opius anastrephae,* the native parasite attacking *Anastrepha* spp. in Puerto Rico, were made to Hawaii for trial against the Mediterranean fruitfly. On October 12 and 15, 1935, two shipments containing 640 and 137 adults of this parasite, respectively, were sent to Hawaii by air express.

A consignment of 1,300 *Dirhinus giffardii,* the pupal parasite, imported from Hawaii, was sent to the Dominican Republic in October 1938. A second shipment of 150 adults of the same species was sent to the Dominican Republic in August 1939.

Only one introduced parasite species was ever recovered. Collections of various fruits infested with West Indian fruitflies have been made at frequent intervals and in large numbers throughout the island since liberations were made. In addition large collections of material made by workers of the Bureau of Entomology and Plant Quarantine stationed in Mayaguez have been available for observational purposes. However, with the exception of one species, *Opius tryoni,* introduced from Hawaii, there were never any recoveries. Recoveries of *Opius* tryoni were made from *Anastrepha mombinpraeoptans* infesting jobo at Mayaguez in August, September, and October 1935 and at Sabana Grande in July and August 1936; the latter recovery was made by J. W. Balock of the Bureau of Entomology and Plant Quarantine while carrying on other work with *Anastrepha* spp. Despite the fact that these recoveries were made some months after the last liberations and also at considerable distances from the original liberation points, the species has since disappeared and apparently has been unable to maintain itself.

Recoveries of *Pachycrepoideus dubius* were made at a number of points in the vicinity of liberations. However, this cosmopolitan parasite species is so well distributed over the world that it may possibly have already existed in Puerto Rico, although its presence had never previously been recorded in the island. The species is now known to be present in many sections of the island; however, the percentage of parasitization has always been low and it is questionable whether it is established as a result of importations or is an indigenous species.

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A SUPPLEMENT TO "INSECTAE BORINQUENSES"

Compiled by
George N. Wolcott

The purpose of "Insectae Portoricensis" was to give the records of all the insects (economic or otherwise, but especially and in considerable detail the notes concerning those of economic importance) from the Island then officially called Porto Rico (which includes Culebra, Vieques and minor islands on the east, and Desechco and Mona Islands on the west), up to shortly before the date of publication, March 1924. Five months later a supplement was issued, to give the determinations received too late for inclusion in the original annotated list. "Insectae Borinquenses," issued as the January 1936 number of the Journal of Agriculture of the University of Puerto Rico, but actually not published until July tenth of that year, was intended as a record of all determinations up to the end of June 1935, for the same Island, now officially known as Puerto Rico. In the present supplement, references to these original lists are abbreviated to "IP" and "IB" with a dash followed by the page number. The MS was submitted for publication on July 1, 1940, and is intended to cover all records up to that date. Several important publications received shortly afterwards are, however, noted [in brackets] in the bibliography, although the additional records and numerous changes in the synonymy have not been made in the list of insects itself.

Mr. Richard Faxon, who left Puerto Rico in August 1935, had made available for publication in "Insectae Borinquenses" all the interception records of the San Juan office of the Plant Quarantine Service of the Federal Bureau of Entomology and Plant Quarantine, of which he was in charge at that time. For this supplement, Mr. W. T. Owrey, in charge until May 1940, made available all the records of the succeeding five-year period, June 1935 to June 1940. The personnel of the office for the period is as follows:

Date	*Date of Arrival*	*Date of Departure*
A. G. Harley	September 1929 (at Mayaguez)	August 1935
A. S. Mills	December 1929	July 1937
R. G. Oakley	April 1931 (at Ponce)	February 1937
W. A. McCubbin	July 1935	July 1939
H. G. Taylor	July 1935	August 1939
W. T. Owrey	August 1935	May 1940
G. A. Pfaffman	March 1937 (at Mayaguez)	April 1940
I. W. Berryhill	July 1937	January 1939
R. G. Smith	February 1939	April 1940
F. A. Johnston	March 1940	At present on duty in Puerto Rico

It should be especially noted that the records of insects collected by the men of this office as published in "Insectae Borinquenses" and in this supplement are preceded by "I No.", an abbreviation for "Interception Number," and all represent determinations by specialists of the U. S. National Museum.

The records of what was formerly the Insular Experiment Station, now the Agricultural Experiment Station of the University of Puerto Rico at Rio Piedras, are given as an accession number separated by a dash from the year of collection, and, unless followed by a note as to the person making the determination, the insect presumably was identified by the person making the collection. During the period covered, the compiler has been in charge of the Division of Entomology, with Mr. Francisco Sein working on the problem of coffee leaf-miner. The only change in personnel was the appointmen in September 1936 of Mr. Luis F. Martorell, to work on the problem of control of the sugar-cane moth-borer by *Trichogramma*. Mr. Martorell, graduated from the College of Agriculture in Mayaguez in 1932, received his M.S. from Ohio State in 1934, and for a year had been teaching (and collecting insects) in Venezuela. More recently he had been in the local Forest Service. He is an enthusiastic collector of insects, and most of the recent records in the Station catalog, especially from Mona Island, are due to his efforts.

Dr. Stuart T. Danforth, formerly Professor of Zoology and Entomology at the College of Agriculture at Mayaguez, shortly before his death sent all the records of Mallophaga identified up to that time from the birds which he had collected. Since then, Mr. J. A. Ramos, at present in charge of the Department, has sent all the more recent records of Mallophaga collected by Dr. Danforth, as well as of leaf-hoppers and Carabid and other beetles in his own collection. The latter are here recorded as "Ramos Col."

In contrast to the long period when no entomologist has been present at the Federal Agricultural Experiment Station at Mayaguez, for a number of years it has more recently been host for Mr. L. C. McAlister, Jr., and Mr. J. W. Balock, of the Division of Fruit Fly Investigations, Bureau of Entomology and Plant Quarantine. As stated on page 101 of the 1936 report of the Station, it "also furnished office and laboratory quarters for fifteen investigators engaged on entomological projects under funds provided by the Agricultural Adjustment Administration. These entomologists included M. R. Smith, who was engaged on investigations on the ant-scale-mealybug relationship on coffee and pineapples; H. K. Plank, working on the rhinoceros beetle and other coconut insects; L. C. Fife, engaged in a survey and life-history studies on pink bollworm and other cotton insects; H. L. Dozier, working on investigations of screw-worms, horn flies and other cattle insects; G. S. Tulloch, engaged in a survey and study of mosquitoes; L. B. Scott, engaged in a study of bean-pod borers and onion thrips; and A. H. Madden, engaged in an investigation of the mole-cricket and its control.

"S. H. Vandeburg, F. M. Wadley and H. D. Tate were engaged jointly in a study of the insect transmission of sugarcane mosaic, B. A. App was engaged in a study of the control of the corn earworm, the corn silk maggot, and the armyworm. K. A. Bartlett was engaged in the receipt and liberation of introduced beneficial insects, natural enemies of insect pests in Puerto Rico. S. M. Dohanian was engaged in exploration for natural enemies of Puerto Rican insects pests, and in this pursuit spent most of the year in Trinidad, British Guiana and Peru."

Such a wealth of entomological talent, however, could not long be retained at Mayaguez, and most of these men were in Puerto Rico only a little longer than one year. Despite the shortness of their stay, nearly every one has added to a knowledge of the insects in Puerto Rico by one or more published papers, and two of them, who eventually were more permanently appointed at the Mayaguez Station, Mr. K. A. Bartlett and Mr. H. K. Plank, have recently been very active in making available the results of their investigations.

Dr. Julio Garcia-Diaz, Dean of the College of Arts and Sciences, University of Puerto Rico; Mr. Boyd Palmer of the Polytechnic Institute at San German; Dr. W. A. Hoffman of the School of Tropical Medicine at San Juan; and one enthusiastic amateur in the collection and rearing of butterflies, Mr. Cesáreo Perez, have also materially added in studies of local insects.

BIBLIOGRAPHY

Anon. "Report of the Puerto Rico Experiment Station, 1935. pp. 34. Washington, D. C., July 1936.

"Report of the Puerto Rico Experiment Station, 1936." pp. 103. Washington, D. C., August 1937.

"Report of the Puerto Rico Experiment Station, 1937." pp. 115. Washington, D. C., November 1939.

"Report of the Puerto Rico Experiment Station, 1938." pp. 137. Washington, D. C., November 1938.

Bartlett, K. A. "A Dryinid Parasite attacking *Baldulus maidis* in Puerto Rico." Jour. Agr. Univ. P. R., **22**(4): 479-8. San Juan, (March 23) February 1939.

"A Search in the Guianas and Trinidad for predatory beetles of bamboo scales." Jour. Agr. Univ. P. R., **22**(4): 493-5. San Juan, (March 23) February 1939.

"Introduction and Colonization of two Parasites of the Pineapple Mealybug in Puerto Rico." Jour. Agr. Univ. P. R., **23**(2): 67-72, ref. 2. San Juan, August 1939.

"The Introduction into Puerto Rico of Beneficial Insects to aid in the Control of the Horn Fly of Cattle." Agr. Notes No. 88. Mayaguez, March 31, 1939. (Mimeographed.)

Dohanian, S. M. "The Introduction of Parasites of the Sugarcane Borer into Puerto Rico." Jour. Agr. Univ. P. R., **21**(2): 237-241. San Juan, (July) April 1937.

"The Importation of Coccinellid Enemies of Diaspine Scales into Puerto Rico." Jour. Agr. Univ. P. R., **21**(2): 243-247, ref. 2. San Juan, (July) April 1937.

Fife, L. Courtney "Insects and a Mite found on Cotton in Puerto Rico, with Notes on their Economic Importance and Natural Enemies." Bulletin No. 39, P. R. Agr. Expt. Sta., Mayaguez, P. R., pp. 14, ref. 45. Washington, D. C., March 1939.

Gage, Charles E. "The Tobacco Industry in Puerto Rico." Circ. No. 519, pp. 54, fig. 18, ref. 11. Washington, D. C., March 1939.

Garcia-Diaz, Julio "An Ecological Survey of the Fresh Water Insects of Puerto Rico, Appendix A." Jour. Agr. Univ. P. R., **22**(1): 94-96. San Juan, (April 15) January 1938: lists of determinations.

Jepson, W. F. "Report on the Search for Parasites for *Phytalus smithii* Arr." pp. 66, ref. 13 and 31. Port-Louis, Mauritius, 1936.

Martorell, L. F. "Some Notes on Forest Entomology." Caribbean Forester, **1**(1): 25-6, **1**(2): 31-2, **1**(3): 23-4. New Orleans, La., October 1939, January and April 1940.

Martorell, L. F. & Wolcott, G. N. "Forest Tree Insects." *in* Ann. Rept. Agr. Expt. Station, Fiscal Year 1937-38. p. 44. San Juan, 1939.

[Needham, J. G. "Insects from Seed Pods of the Primrose Willow, *Jussizea angustifolia*." Proc. Ent. Soc. Washington, **43**(1): 2-6, fig. 6. Washington, D. C., January 1941.]

Noble, L. W. & Hunt, W. T. "Imported Parasites of the Pink Bollworm at Presidio, Texas, 1932-36." Jour. Ec. Ent., **30**(6): 842-4. Menasha, Wis., December 1937.

[Plank, H. K. & Smith, M. R. "A survey of the pineapple mealybug in Puerto Rico and preliminary studies of its control." Jour. Agr. Univ. P. R.,**24**(2): 49-76, fig. 6, ref. 11. San Juan, (August) April 1940.]

[Scott, L. B. "The bean pod borers in Puerto Rico." Jour. Agr. Univ. P. R., **24**(2): 35-47, fig. 2, ref. 3. San Juan, (August) April 1940.]

Smith, M. R. "The Ants of Puerto Rico." Jour. Agr. Univ. P. R., **20**(4): 819-875, fig. 19, ref. 16. San Juan, (January 1937) October 1936.

vanVolkenberg, H. L. "Check List of Parasites found among principal domestic Animals in Puerto Rico." Proc. Helminthological Soc. Washington, **5**(1): 7-8. Washington, D. C., 1939.

Wadley, F. M. "Observations on some Insects associated with Sugarcane in Puerto Rico." Jour. Agr. Univ. P. R., **21**(2): 103-114, ref. 15. San Juan, April 1937.

Wolcott, G. N. "Report of the Entomologist." *in* Ann. Rpt. Director, Year 1933-34. pp. 142-144. San Juan, 1935.

"What the Giant Surinam Toad, *Bufo marinus* L., is eating NOW in Puerto Rico." Jour.

Agr. Univ. P. R., **21**(1): 79-84, ref. 3. San Juan, January 1937.

"Annual Report for the Fiscal Year 1934-1935, Division of Entomology." *in* Ann. Rpt. Agr. Expt. Station, Fiscal Year 1934-35, pp. 41-49. San Juan, 1937.

"Annual Report for the Fiscal Year 1935-1936 of the Division of Entomology." *in* Ann. Rpt. Agr. Expt. Station, Fiscal Year 1935-36, pp. 53-64. San Juan, 1937.

"Annual Report of the Division of Entomology for the Fiscal Year 1936-1937." *in* Ann. Rpt. Agr. Expt. Station, Fiscal Year 1936-37, pp. 82-102. San Juan, 1938.

"Entomological Investigations." *in* Ann. Rpt. Agr. Expt. Station, Fiscal Year 1937-38, pp. 33-34. San Juan, 1939.

"A Parasite of the Puerto Rican Mole-Cricket." Science **89**(2318): 508-9. New York, June 2, 1939.

"The Entomologist looks at Maga." Caribbean Forester, **1**(2): 29-30. New Orleans, La., January 1940.

Wolcott, G. N. & Martorell, L. F. "Two Insects new to Puerto Rico: the Lycid Beetle, *Thonalmus chevrolati* Bourgeois, and the Ephydrid Fly, *Ephydra gracilis* Packard." Jour. Agr. Univ. P. R., **21**(4): 535-8. San Juan, November 12, 1937.

"The Ant, *Monomorium carbonarium ebeninum* Forel, in a new Role, as Predator on the Egg-Clusters of *Diatraea saccharalis* F., in Puerto Rican Cane Fields." Jour. Agr. Univ. P. R., **21**(4): 577-9. San Juan, (November 12) October 1937.

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COLLEMBOLA

Entomobrya cubensis Folsom—det. H. B. Mills
Anon 39-118: from bamboo twigs.
Fife 39-11: on the underside of cotton leaves.

Salina wolcotti Folsom
Fife 39-11: numerous on the underside of cotton leaves.
in houses (38-39).

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ORTHOPTERA

FORFICULIDAE

Labidura riparia Pall.
at light, lighthouse, Mona Id. (261-40 det. A. B. Gurney).

Doru albipes F.
in hollow twigs of bucare at Maunabo (47-38); in sawfly cocoon on atchiote at Bayamon (I No. 6205).

Doru lineare Esch.
Anon 39-120: injuring vanilla leaf-tips.

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Psalis americana var. **gagathina** Burmeister
Anon 39-109: found in tunnels of *Cosmopolites sordidus* Germar at Juana Diaz, and fed on larvae in captivity.

BLATTIDAE

Aglaopteryx absimilis Gurney, A. B., "Studies in certain Genera of American Blattidae (Orthoptera)." Proc. Ent. Soc. Washington, **39**(5): 101-112, pl. 1. Washington, D. C., May 1937: TYPE from Cayey, P. R., "in cocoons of *Megalopyge krugii* on trunk of bucare tree" (R. T. Cotton).

Aglaopteryx diaphana F. is a Cuban species, according to Gurney (above), and the records under this name for Puerto Rico should be under **A. devia** Rehn.
between leaves of *Samanea saman* at Salinas (261-39).

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Blattella germanica L.
in houses, Mona Id. (109-39, 255-40).

Ischnoptera rufa DeGeer
in bananas at Lares (282-39); in fruit fly trap at Bayamon (I No. 6917).

Symploce bicolor P. B.—det. A. B. Gurney
on Mona Id. (276-40).

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Pelmatosilpha coriacea Rehn

under bark of *Sideroxylon foetidissimum* at Ciales (417-40); on Mona Id. (106-39).

Periplaneta americana L.

Wolcott 37-81: in toad excrement.

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MANTIDAE

Callimantis antillarum Saussure

on Mona Id. (14-37 det. A. B. Gurney, 53-40, 252-40).

Diapherodes sp., near **longiscapha** Redtenbacher

on El Yunque (89-35 det. A. B. Gurney), at Rio Blanco (62-39).

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PHASMIDAE

Aplopus sp.—det. A. B. Gurney

on Mona Id. (16-37).

Antillophilus restrictus Redtenbacher, J., (as *Pericentrus*) "Die Insektenfamilie der Phasmiden." 1908, p. 357: TYPE from Puerto Rico.

Rehn, J. A. G. & Hebard, Morgan, "New Genera and Species of West Indian Mantidae and Phasmidae (Orthoptera)." Trans. Amer. Ent. Soc., **64**(1040): 33-55, pl. 2. Philadelphia, March 7, 1938: at Arecibo, P. R.

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ACRIDIDAE (LOCUSTIDAE)

Sphingonotus haitiensis Saussure

Rehn, J. A. G. & Hebard, Morgan, "New Genera and Species of West Indian Acrididae." Trans. Amer. Ent. Soc., **64**( ): 201-226, pl. 1. Philadelphia, August 5, 1938: at Ensenada, Coamo Springs and Manati.

at the airport, Mona Id. (105-39).

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Schistocerca americana Drury

at Mayaguez (I No. 7425), on Mona Id. (104-39) abundant on the plateau in March (255-40); on sugarcane at Maunabo (316-39), at Fajardo (14-39) nymphs in November, adults in February and March.

TETTIGONIIDAE (LOCUSTIDAE)

Microcentrum triangulatum Brunner

on Mona Id. (147-39, 254-40); nymphs and adults feeding on leaves of moca, *Andira inermis,* at Cayey (118-40).

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GRYLLIDAE

Scapteriscus vicinus Scudder—the "changa"

Smith (37-845: eggs and nymphs eaten by *Pheidole subarmata* var. *borinquenensis* Wheeler (A. H. Madden).

Madden, A. H., "Notes on the Changa, or West Indian Mole Cricket, in Puerto Rico in 1935 and 1936." Jour. Agr. Univ. P. R., **21**(2): 115-120. San Juan, April 1937.

Wolcott 37-62 to 64: initiation of an attempt to introduce a parasite of.

Wolcott 38-96 to 98: difficulties encountered.

Wolcott 39-43 to 44: successful mass introduction of adult wasp parasites when accompanied by live parasitized hosts.

Wolcott, G. N., "Presence of Host Keep Parasites alive in Captivity." Science, **87**(2259): 352. New York, April 15, 1938.

Wolcott, G. N., "The Introduction into Puerto Rico of *Larra americana* Saussure, a specific Parasite of the 'Changa,' or Puerto Rican Mole-Cricket, *Scapteriscus vicinus* Scudder." Jour. Agr. Univ. P. R., **22**(2): 193-218, fig. 4, ref. 16. San Juan, May 1938.

Gage 39-21: a short economic account.

Fife 39-11: attacking young cotton seedlings in sandy soil.

Wolcott 39-509: establishment of *Larra americana* in Puerto Rico at two points.

[Wolcott, G. N., "The Establishment in Puerto Rico of *Larra americana* Saussure." Jour. Ec. Ent., **34**(1): 53-56, ref. 7. Menasha, Wis., April 23, 1941.]

adults at light at Guajataca (51-39); at top of mountains (elev. 1,500 ft.), Mountain Top Nursery, Patillas (10-39).

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Amphiacusta caraibea Saussure

in caves and houses, Mona Id. (146-39).

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ISOPTERA

Wolcott, G. N., "Comején y Polilla." Bol. No. 48. Estacion Experimental Agricola de Rio Piedras, p. 26, fig. 13. San Juan, March 20, 1939.

Dr. T. E. Snyder has prepared a list under the latest accepted names, here used, of all the authentic records of termites from Puerto Rico.

KALOTERMITIDAE

Kalotermes mona Banks 19-478: TYPE from Mona Id.

Kalotermes (K.) snyderi Light

all the previous records of *K. marginipennis* Latreille in Puerto Rico should be referred to this species, including the illustration of a soldier in Wolcott 39-24.

in sanguinaria tree, Mona Id. (169-39 det. T. E. Snyder).

Kalotermes (Neotermes) castaneus Burmeister

Kalotermes (Cryptotermes) brevis Walker
(as *Cryptotermes*) Wolcott 37-54 to 55: an investigation initiated (1935), preliminary tests with paradichlorobenzine and with "chlorasol."
Wolcott 38-83: preliminary results in wood resistance.
Wolcott 39-34 to 36: woods most resistant to attack.
Wolcott 39-14 to 23: an extended, illustrated account.
Wolcott 40-29: natural resistance of heartwood of mahogany and maga.
[Wolcott, G. N., "A List of Woods arranged according to their Resistance to the Attack of the 'Polilla,' the Dry-Wood Termite of the West Indies, *Cryptotermes brevis* Walker." Caribbean Forester, **1**(4): 1-10, fig. 2. New Orleans, La., July 1940.]

page 47.
Kalotermes (Cryptotermes) cavifrons Banks
Snyder: at Mayaguez in 1936.

Kalotermes (Calcaritermes) corniceps Snyder

Kalotermes (Glyptotermes) pubescens Snyder
in stump of *Miconia guianensis* on El Yunque (38-39 det. T. E. Snyder); in corner post of Sierra Palm cottage, El Yunque (114-40 det. T. E. Snyder).

RHINOTERMITIDAE

Heterotermes convexinotatus Snyder
Wolcott 39-23: mention.

Heterotermes tenuis Hagen
Wolcott 39-23 to 25: an economic account.
in houses at Aguadilla (55-39 det. T. E. Snyder); attacking books in concrete house, entrance through wooden doorsill, later through cracks between tiles of floor (54-38 det. H. R. Johnson).

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TERMITIDAE

Nasutitermes (N.) acajutlae Holmgren (?)
(as *N. creolina* Banks) Banks 19-484; from Vieques Id., and Porto Rico, "probably what Holmgren records from St. Thomas as *E. acajutlae*."
(as *N. creolina* Banks) Wolcott 21-3, IP-36 and IB-49: nest in algarrobo tree (170-21). "The workers bit viciously."

Nasutitermes (N.) costalis Halmgren
(as *N. sanchezi* Holmgren) Banks 19-487: "Practically identical as regards adults with *N. morio*." = *N. costalis*.
Wolcott 39-5 to 14: an illustrated, economic account.

[Martorell, L. F., "Some Notes on Forest Entomology IV." Caribbean Forester, **2**(2): 80-2. New Orleans, La., January 1941: listing 84 trees attacked.]

adults pursued by bat at Guajataca (50-39); destroying all the wood in almacigo fence-post at Vega Baja (156-40); nest in heartwood of live mahogany stump at Aguadilla (372-40), in mahogany tree at Aguadilla (270-39), at Dorado (383-40); nest in grenadilla tree, *Buchenavia capitata,* at Las Marias (271-39); nest in tabonuco tree, *Dacryodes excelsa,* at Matrullas Dam (310-39); nest in acacia tree, *Albizzia lebbeck,* at Lares (70-40); nest in roble tree, *Tabebuia pallida,* at Lares (70-40); nest in morál tree, *Cordia sulcata,* at Cayey (125-40); nest in guamá tree, *Inga laurina,* at Cayey (124-40); nest in cupéy, *Clusia rosea,* at Isabela (421-40); nest in guamá americano tree, *Pithecollobium* sp. at San Sebastian (425-40).

(page 47)

Nasutitermes (Tenuirostritermes) discolor Banks 19-489 (as *Constrictotermes*): TYPE from Culebra Id., Adjuntas, Manati and El Yunque, P. R.

in rotten tree on El Yunque, (343-39 det. T. E. Snyder).

Nasutitermes (Tenuirostritermes) wolcotti Snyder

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Anoplotermes (A.) sp.

Microcerotermes arboreus Emerson

Banks 19-482: "described from specimens in gum-copal, and Hagen identified it with specimens from Porto Rico."

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EMBIDINA

Oligotoma latreillei Rambur ? or near—det. A. B. Gurney

between pages of book (39-38).

CORRODENTIA

ATROPIDAE

Liptoscelis (Troctes) divinatorius Müller

scavenger or symbiotic with *Cryptotermes brevis* (1-37 det. N. Banks); on Hibiscus at Vega Alta (I No. 6312); from bird skins collected by Dr. Stuart T. Danforth on Vieques Id.—det. A. B. Gurney.

Ectopsocus sp.—det. A. B. Gurney

on casein-washed walls, School of Tropical Medicine (W. A. Hoffman).

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MALLOPHAGA

Eomenacanthus stramineus Nitzsch

Anon 36-23: in table 6, the species of lice found in Puerto Rico by Dr. H. L. vanVolkenberg, the only record not given in "Insectae Borinquenses" is of this species "on chicken."

Dr. H. E. Ewing has determined the following from birds collected by the late Dr. Stuart T. Danforth.

Menopon sp.

on Semipalmated Plover, *Charadrius haiticula semipalmatus,* at Cartagena Lagoon x-4-30.

Actornithophilus sp.

on Semipalmated Sandpiper, *Ereunetes pusillus,* at Cartagena Lagoon, ix-30-30; on Stilt Sandpiper, *Micropalama himantopus,* at Cartagena Lagoon, ix-30-30; on Mangrove Cuckoo, *Coccyzus minor teres,* at Cartagena Lagoon, x-4-30; on Southern Little Blue Heron, *Florida caerulea caerulescens,* at Cartagena Lagoon, x-4-30.

Heleonomus sp.

on Lesser Yellowlegs, *Tringa flavipes,* from Vieques Id., xii-26-35.

Menacanthus chrysophaeum Kellogg

on Grey Kingbird, *Tyranus d. dominicensis,* from Vieques Id., xii-28-35.

Colpocephalum flavescens Nitzsch

on Antillean Sparrow Hawk, *Falco sparverius loquaculus,* from Vieques Id., xii-28-35; on Pearly-Eyed Thrasher, *Margarops f. fuscatus,* from Vieques Id., xii 28-35.

Colpocephalum sp.

on Judio, *Crotophaga ani,* at Mayaguez, ii-8-36; another from Vieques Id., xii-26-35; on Jamaican Mockingbird, *Mimus p. orpheus,* from Vieques Id., xii-31-36; on Semipalmated Plover, *Charadrius h. semipalmatus,* at Mayaguez, x-21-30.

Myrsidea incerta Kellogg

on Grey Kingbird, *Tyranus d. dominicensis,* xii-28-35, on Antillean Sparrow Hawk, *Falco s. loquaculus,* xii-28-35, on P. R. Woodpecker, *Melanerpes portoricensis,* xii-31-35, on Judio, *Crotophaga ani,* xii-26-35, on Pearly-Eyed Thrasher, *Margarops f. fuscatus,* xii-28-35, all from Vieques Id.; and on P. R. Thrush, *Mimocichla a. portoricensis,* at Mayaguez, x-18-30.

Myrsidea sp.

on P. R. Thrush at Mayaguez, ii-7-36; on P. R. Petchary, *Tolmarchus taylori,* from Vieques Id., xii-26-35; on P. R.

Grackle, *Holoquiscalus n. brachypterus,* from Vieques Id., xii-30-35.

Amyrsidea aurifasciatum Kellogg—det. H. E. Ewing
on "rabijunco" or frigate bird, *Fregata magnificens,* from Mona Id. (387-39).

RICINIDAE

Ricinus invadens Kellogg
on Prarie Warbler, *Dendroica d. discolor,* at Mayaguez, ii-7-36; on warbler or reinita, xii-29-35.

Ricinus sp.
on Water-Thrush, *Seiurus n. noveboracensis,* from Vieques Id., xii-30-35; on P. R. Grackle, *Holoquiscalus n. brachypterus,* from Vieques Id., xii-30-35.

PHILOPTERIDAE

Lipeurus sp. ?
on Pearly-Eyed Thrasher, *Margarops f. fuscatus,* from Vieques Id., xii-28-35.

Philopterus quiscali Osborn
on P. R. Grackle, *Holoquiscalus n. brachypterus,* from Vieques Id., xii-30-35.

Philopterus subflavescens Geoffrey ?
on Martinique Dove, *Oreopeleia m. mystacea,* xii-28-35; on P. R. Ground Dove, *Columbigallina p. portoricensis,* xii-24-35, on Jamaican Mockingbird, *Mimus p. orpheus,* xii-31-35, on Pearly-Eyed Thrasher, *Margarops f. fuscatus,* xii-28-35, all from Vieques Id.

Degeeriella complexiva Kellogg & Chapman
on Stilt Sandpiper, *Micropalama himantopus,* at Cartagena Lagoon, ix-30-30.

Degeeriella eustigma Kellogg
on Jamaican Mockingbird, *Mimus p. orpheus,* from Vieques Id., xii-31-35.

Degeeriella illustris Kellogg
on P. R. Grackle, *Holoquiscalus n. brachypterus,* from Vieques Id., xii-30-35.

Degeeriella sp.
on Gray Kingbird, *Tyranus d. dominicensis,* from Vieques Id., xii-28-35; on Lesser Yellowlegs, *Tringa flavipes,* from Vieques Id., xii-26-35; on Southern Little Blue Heron, *Florida c. caerulescens,* at Cartagena Lagoon, x-4-30; on Semipalmated Plover, *Charadrinus h. semipalmatus,* at Mayaguez, x-21-30.

Esthiopterum gracilicornis major Kellogg—det. H. E. Ewing
on "rabijunco" or Frigate Bird, *Fregata magnificens,* from Mona Id. (388-39).

Esthiopterum sp.
on Gray Kingbird, *Tyranus d. dominicensis,* from Vieques Id., xii-28-35; on Judio, *Crotophaga ani,* at Mayaguez, ii-8-36; on P. R. Grackle, *Holoquiscalus n. brachypterus,* from Vieques Id., xii-26-35 and from the same host and locality, xii-26-35, possibly a new species.

Physconelloides near **zenaidurae** McGregor
on P. R. Ground Dove, *Columbigallina p. portoricensis,* from Vieques Id., xii-24-35; on P. R. Golden Warbler, *Dendroica p. cruciana,* from Vieques Id., xii-27-35.

Physconelloides sp., probably new
on Gray Kingbird, *Tyranus d. dominicensis,* from Vieques Id., xii-28-35.

Physconelloides sp.
on Martinique Dove, *Oreopeleia m. mystacea,* from Vieques Id., xii-28-35.

Columbicola sp. nov.
on Gray Kingbird, *Tyranus d. dominicensis,* xii-28-35, on Antillean Sparrow Hawk, *Falco s. loquaculus,* xii-28-35, on P. R. Ground Dove, *Columbigallina p. portoricensis,* xii-24-35, all from Vieques Id.

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EPHEMERIDA

Traver, Jay R., "Mayflies of Puerto Rico." Jour. Agr. Univ. P. R., 22(1): 5-42, pl. 3, ref. 23. San Juan, (April 15) January 1938.

Neohagenulus julio Traver 38-9: TYPE from Adjuntas, P. R.

Neohagenulus tinctus Traver 38-12: TYPE from Luquillo Mts., P. R.

Neohagenulus luteolus Traver 38-13: TYPE from Luquillo Mts., P. R.

Neohagenulus spp. No. 1 & No. 2 Traver 38-16: nymphs.

Borinquena carmencita Traver 38-18: TYPE from El Yunque, P. R.

Borinquena contradicens Traver 38-20: TYPE from La Mina, El Yunque, P. R.

Caenis spp. No. 1 & No. 2 Traver 38-22: nymphs.

Callibaetis completa Banks ?
Traver 38-24: collected by F. Sein at Rio Piedras.
females (7-30).

Callibaetis sp. Traver 38-25: nymphs, possibly *C. completa.*

Baëtis garcianus Traver 38-26: TYPE from Rio Tamana, P. R.

Baëtis spp. No. 1 & No. 2 Traver 38-28, 29: nymphs.

Cloëodes maculipes Traver 38-33: TYPE from Luquillo Mts., P. R.

Cloëodes portoricensis Traver 38-36: TYPE from Lares, P. R.

Cloëodes consignatus Traver 38-37: TYPE from Rio Yunez, P. R.

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ODONATA

Garcia-Diaz, Julio, "An Ecological Survey of the Fresh Water Insects of Puerto Rico. I. The Odonata: with new Life-Histories." Jour. Agr. Univ. P. R., **22**(1): 43-97, pl. 8, ref. 44. San Juan, (April 15) January 1938.

LIBELLULIDAE

Orthemis ferruginea F.
common on Mona Id. (251-40 det. J. G. Needham).

page 57
Erythrodiplax umbrata L.
on Mona Id. (78-39, 250-40 det. J. G. Needham).

page 58
Cannacria herbida Gundlach
(as *Brachymesia*) Klots 32-51: IB-58:
Garcia-Diaz 38-58: generic transfer.

page 59
Idiataphe cubensis Scudder
(as *Ephidatia*) IB-59:
Garcia-Diaz 38-60: generic transfer.

page 60
Enallagma cultellatum Hagen
(as *E. cardenium* Selys—det. J. G. Needham) IB-60:
Garcia-Diaz 38-69: re-identification.

Enallagma civile Hagen
on Mona Id. (249-40 det. J. G. Needham).

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NEUROPTERA

MYRMELEONIDAE

Psammoleon bistichus Hagen—det. N. Banks
common at light, Mona Id. (153-39, 236-40).

ASCALAPHIDAE

Ululodes opposita Banks, Nathan, "Antillean Ascalaphidae." Jour. Agr. Univ. P. R., **22**(2): 177-180, pl. 1. San Juan, (May) April 1938: TYPE from Cabo Rojo Lighthouse, P. R.

a pair, resting on bushes, Faro de Cabo Rojo (65-37, 66-37 TYPES); at light, Mona Id. (154-39 det. N. Banks).

TRICHOPTERA

RHYACOPHILIDAE

Atopsyche sp.—det. C. Betten
Garcia-Diaz 38-96: No. 84.

PHILOPOTAMIDAE

Chimarrha albomaculata Kolbe 88-175: TYPE from P. R.
Gundlach.
IP-35 & IB-63: adults common at light at Mameyes (197-13 det. N. Banks).
Garcia-Diaz 38-96: No. 80.
Palmer, Boyd B., "A Contribution to the Life-History of *Chimarrha albomaculata* Kolbe from Puerto Rico (Trichoptera: Philopotamidae)." Ann Ent. Soc. America, **31**(1): 69-73, pl. 2, ref. 6. Columbus, Ohio, March 1938.

Chimarrha sp.—det. C. Betten
Garcia-Diaz 38-96: No. 81.

SERICOSTOMATIDAE

Helicopsyche sp.—det. C. Betten
Garcia-Diaz 38-96: No. 73, under Helicopsychinae.

CALAMOCERATIDAE

Phylloicus sp.—det. A. B. Gurney
in fruit-fly trap at Mayaguez (I No. 6861).

LEPTOCERIDAE

Setodes candida Hagen
Gundlach. Kolbe. IP-35 & IB-63.

Setodes sp.—det. C. Betten
Garcia-Diaz 38-96: No. 97.

HYDROPSYCHIDAE

Smicridea sp.—det. C. Betten
Garcia-Diaz 38-96: No. 74.

POLYCENTROPIDAE

New Genus—det. C. Betten
Garcia-Diaz 38-96: No. 82.

PSYCHOMYIDAE

Lype sp.—det. C. Betten
Garcia-Diaz 38-96: No. 83.

HYDROPTILIDAE

Hydroptila sp.—det. C. Betten
Garcia-Diaz 38-96: No. 75.

Neotrichia sp.—det. C. Betten
Garcia-Diaz 38-96: No. 76.

New Genera—det. C. Betten
Garcia-Diaz 38-96: No. 77.

Oxyethira sp.—det. C. Betten
Garcia-Diaz 38-96: No. 78.

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THYSANOPTERA

Heterothrips sericatus Hood
at Palo Seco (I No. 6504).

Chirothrips mexicanus Crawford
Wadley 37-107: in heads of *Eleusine indica.*

Heliothrips haemorrhoidalis Bouché
Fife 39-11: on wild and cultivated cotton, causing damage.
on grape-fruit at Palo Seco (I No. 5987).

Selenothrips rubrocinctus Giard
Anon 38-99: *Dasyscapus parvipennis* Gahan, a parasite of, introduced from the Gold Coast, via Trinidad, by S. M. Dohanian, reared and liberated in P. R. by K. A. Bartlett.
Anon 39-108: not recovered.
on almendra at Maunabo (7-40), at Dorado (I No. 6634); on *Coccolobis laurifolia* at Dorado (I No. 6532).

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Frankliniella insularis Franklin
Fife 39-11: of slight importance on cotton.
in flowers of gardenia at Caguas (I No. 6495); in flowers of cannon-ball tree, *Couroupita guianensis,* at Mayaguez (I No. 6857).

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Thrips tabaci Lindemann
Anon 37-45: experiments in control conducted by L. B. Scott.
Anon 39-108: host of *Dasyscapus parvipennis* Gahan in the laboratory.
on onions, Mona Id. (29-40).

Taeniothrips simplex Morison—det. F. André
on gladiolus (I No. 7207), at Barceloneta (97-40 det. J. R. Watson).

Haplothrips gowdeyi Hood
Fife 39-11: of slight importance on cotton.
on *Blechum blechum* at Guaynabo (I No. 7178); on tuberose flowers at Barceloneta (96-40 det. J. R. Watson).

Aleudrothrips fasciapennis Franklin
on coconut palm (I No. 6113).

Gynaikothrips uzeli Zimmerman
on *Ficus nitida* at Hda. Santa Catalina, El Yunque (354-39, 351-40).

page 70

ANOPLURA

for **Phthrirus,** read **Phthirius**

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HOMOPTERA

CICADIDAE

Proarna hilaris Germar
at light in the Condado (I No. 7311, 7452); abundant on trees of *Samanea saman* at Salinas (247-39).

MEMBRACIDAE

Nessorhinus gibberulus Stal
on coffee at Mayaguez (I No. 6096); on maga at Villalba (403-40).

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Nessorhinus vulpes Amyot & Serville
on pigeon pea at Mayaguez (I No. 6058).

Monobelus fasciatus F.
on dama de dia, *Cestrum diurnum,* at Guajataca (53-38).

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CERCOPIDAE

Clastoptera brevis Walker
on coffee at Mayaguez (I No. 6098).

Clastoptera sp. "neither *brevis* nor *signifera*" Oman
at Cidra (I No. 6783).

CICADELLIDAE (JASSIDAE)

Oman, P. W., "New Eupterygine Leafhoppers from Puerto Rico (Homoptera—Cicadellidae)." Jour. Agr. Univ. P. R., **21** (4): 567-570, pl. 1. San Juan, (November 12) October 1937.

Agallia albidula Uhler
Fife 39-10: on cotton.
abundant on tobacco at Utuado (10-38); on weeds, Mona Id. (307-40 det. P. W. Oman).

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Agallia pepino DeLong & Wolcott

(as *Agalliopsis*) Anon 38-86: negative as vector of bunchy-top disease of papaya.

page 77

Krisna insularis Oman, P. W., "Two New Leafhoppers from Tropical America." Pan-Pacific Entomologist, **12**(3): 116-118. San Francisco, July 1936: TYPE, a male from Luquillo National Forest, P. R. (W. A. Hoffman).

at light on El Yunque (19-37 det. P. W. Oman, 39-39); a nymph on tender leaf of *Eugenia stahlii,* near El Yunque Rock (143-40).

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Cicadella sirena Stal

Fife 39-10: on cotton.

numerous adults resting on stem of *Lantana camara* killed by fungus, *Isaria* sp., at Guajataca (274-39); on Mona Id. (265-40).

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Cicadella similis Walker

Wadley 37-107: on *Panicum barbinode.*

Fife 39-11: on cotton.

page 80

Kolla fasciata Walker

Wolcott, G. N. & Martorell, L. F., "Leafhopper Reaction to Lawn Sprinkling." Jour. Ec. Ent., **33**(3): 584. Menasha, Wisconsin, June 1940.

an extensive and serious outbreak, attacking and killing gramma grass in lawn near Aguadilla (20-40).

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The legends underneath the two cuts should be transposed.

Xerophloea viridis F.

Fife 39-10: on cotton.

page 83

Deltocephalus flaveolus Osborn—det. J. A. Ramos

at light at Mayaguez, May 24, 1938 (Ramos Col.).

page 84

Poeciloscata histrio F.—det. P. W. Oman

Fife 39-10: on cotton.

on castor bean, Mona Id. (176-39).

page 86

Cicadula maidis DeLong & Wolcott

(as *Baldulus*) Bartlett 39-497; parasitized by a Dryinid, *Gonatopus* near *bicolor* Ashmead.

Wolcott & Martorell 37-537: quoting Mackie on occurrence of this Puerto Rican insect in California.

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Nesostelus incisus Mats.

Wadley 37-107: swept from grasses.

Anon 38-86: negative as vector of bunchy-top disease of papaya.

Protalebra aureovittatus DeLong

on morál, *Cordia sulcata,* at El Verde, Rio Grande (157-40 det J. S. Caldwell).

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Protalebra brunnea Oman 38-567: TYPE from Villalba, P. R.

page 90

Empoasca fabalis DeLong

Anon 37-42: a limiting factor in dry bean production in western P. R. (det. H. L. Dozier).

Anon 38-61: control by pyrethrum-soap spray at 10-day intervals (L. B. Scott).

Anon 38-63: "caused premature defoliation of small-seeded lima bean varieties."

Empoasca gossypii DeLong

Fife 39-10: on cotton, "occasionally - - - abundant enough to attain an economic status."

page 91

Empoasca insularis Oman, P. W., "New Neotropical Empoascan Leaf-Hoppers." Jour. Washington Academy Science, **26**(1): 34-40, fig. 2. Washington, 1936: TYPE from P. R.

Empoasca minuenda Ball

Wolcott 40-30: on maga.

Empoasca papayae Oman 37-570: TYPE from Mayaguez, P. R., on papaya, collected by J. H. Jensen.

Anon 39-125: a possible vector of bunchy-top disease of papaya.

Joruma neascripta Oman 37-568: TYPE from Manati, P. R., from icaco, *Chrysobalanus icaco.*

Dikraneura cedrelae Oman 37-567: TYPE from Villalba, P. R., others from Aibonito and Maricao, on West Indian Cedar, *Cedrela odorata* L. (L. F. Martorell).

Martorell & Wolcott 39-44: defoliating cedro trees.

on leaves of West Indian Cedar at Camp Doña Juana, Toro Negro Unit (21-36 TYPE), others from Villalba, Yabucoa, Aibonito, and Maricao; on host at Lares and Toa Alta (33-38), at Aibonito and Cayey (44-37), at Maricao (390-40), at Patillas (429-40).

Dikraneura (Hyloidea) depressa McAtee

Wolcott 40-30: on maga.

on maga at Arecibo (156-40 det. J. S. Caldwell).

Dikraneura lentrosomae Oman 37-568: TYPE from Mayaguez, P. R., swept from *Centrosema* by F. M. Wadley.

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Hybla maculata McAtee

on emajagua, *Pariti tiliaceum,* at Cayey (159-40), on Mona Id. (215-40 det. J. S. Caldwell).

Typhlocybella minima Baker

Wadley 37-107: swept from *Bradburyana.*

FULGORIDAE

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Catonia cinerea Osborn

Wolcott 40-30: on maga.

page 94

Oliarus complectus Ball

Fife 39-10: on cotton.

on weeds, Mona Id. (307-40 det. P. W. Oman).

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Epiptera floridae Walker—det. P. W. Oman.

at light (I No. 6784).

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Neurotmeta viridis Walker

at light, Mona Id. (282-40 det. P. W. Oman) .

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Colpoptera maculata Dozier

on Mona Id. (307-40 det. P. W. Oman).

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Ormenis marginata Brunnich

Anon 38-92: on *Jasminum pubescens.*

on sea-grape and *Lantana,* Mona Id. (155-39); on *Coccolobis laurifolia,* Mona Id. (33-40); on *Inga vera* at Cayey (111-40).

Ormenis pygmaea F.

on *Lantana,* sea-grape and at light, Mona Id. (156-39); on *Coccolobis laurifolia,* Mona Id. (32-40).

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Ormenis quadripunctata F.

on icaco at Joyuda (I No. 5912); on sea-grape, Mona Id. (170-39); on *Coccolobis laurifolia,* Mona Id. (34-40).

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Flatoides punctata Walker

at light, Mona Id. (157-39 det. P. W. Oman, 264-40); on sea-grape, Mona Id. (158-39 det. P. W. Oman); on *Coccolobis laurifolia,* Mona Id. (35-40).

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Flatoides brunneus Muir

on *Inga vera* at San Sebastian (50-38).

Cedusa santaclara Myers

Wolcott 40-30: on maga.

page 106

Peregrinus maidis Ashmead

Anon 36-15 & Anon 37-67: vector of a corn-stripe disease of corn.

Wadley 37-107: on corn.

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CHERMIDAE (PSYLLIDAE)

Ceropsylla sideroxyli Riley—det. H. L. Dozier

a pit-forming Psyllid on leaves of *Sideroxylon foetidissimum* at Ciales (5-36), on Mona Id. (45-40).

APHIDIDAE

Sipha flava Forbes

Smith 37-832: attended by *Monomorium carbonarium ebeninum* Forel.

Smith 37-854: attended by *Wasmannia auropunctata* Roger.

Wadley 37-103 to 112: hosts, parasites and predators, "among the minor problems of cane growing."

Wolcott 37-47, Wolcott 37-55 & Wolcott 38-89: no suitable outbreaks of for conducting control experiments.

Wolcott 39-37: successful experiment in control by dusting with calcium cyanide dust.

Anon 39-98: control on lemon grass by *Acrostalagmus aphidum* Oud.

on lawn of *Polytrias amaura* at Mayaguez (I No. 5957); on sugar-cane at Arroyo (80-37), practically free from parasites and predators, and suitable for dusting experiment.

page 112

Aphis asclepiadis Fitch—det. P. W. Mason

on *Asclepias curassavica* at Vega Baja (I No. 7215).

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Aphis gossypii Glover

Smith 37-845: attended by *Crematogaster steinheili* Forel.

Smith 37-867: attended by *Prenolepis fulva* Mayr and by *P. longicornis* Latreille.

Fife 39-9: economic importance on cotton, parasites and predators.

on okra at Isla Verde (I No. 7389); on Santa Maria at Vega Alta (I No. 6173); on *Hibiscus bifurcatus* (I No. 6312, 6342); on roble, *Tabebuia pallida*, (I No. 6691), at Cayey (355-40 det. P. W. Mason); on *Citrullus citrullus*, Mona Id. (213-40).

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Aphis maidis Fitch

Wadley 37-103 to 113: hosts, parasites and predators, "Important in mosaic disease dissemination because more abundant in areas of rapid than of slow spread."

on Sudan grass (134-40).

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Aphis spiraecola Patch

Smith 37-866: attended by *Brachymyrmex heeri* Forel.

on grapefruit at Rincón (I No. 6725).

Carolinaia cyperi Ainslie

Wadley 37-107: only on *Cyperus*.

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Hysteroneura setariae Thomas

Wadley 37-103-113: hosts, predators and parasites, "more abundant in dry weather."

Toxoptera aurantiae Koch

Smith 37-845: attended by *Crematogaster steinheili* Forel.

Smith 37-854: attended by *Wasmannia auropunctata* Roger.

on lime (I No. 6600, 6812); becoming very abundant on tender leaves of coffee in air-conditioned greenhouse when humidity did not go below 70% (87-40); on leaves and young shoots of mantecado, *Rapanea ferruginea*, at Maricao, elev. 1,300 ft. (354-40 det. P. W. Mason).

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Macrosiphum (Tritogenaphis) erigeronensis Thomas—det. P. W. Mason

on *Erigeron canadensis* at Dorado (I No. 7208).

Macrosiphum ambrosiae Thomas—det. P. W. Mason

on branches and leaves of straw flower, *Helichrysum bracteatum*, at Camp Doña Juana, Villalba (175-40); on leaves and branches of *Salvia spendens*, Mona Id. (297-40 det. P. W. Mason).

Myzus persicae Sulzer

on papaya fruit at Isabela (38-38 det. P. W. Mason); on turnip leaves (I No. 7211).

Phorodon menthae Buckton—det. P. W. Mason

on mint (I No. 6329).

Pentalonia nigronervosa Cockerell

Smith 37-845: attended by *Pheidole s. borinquenensis* Wheeler.

Smith 37-854. attended by *Wasmannia auropunctata* Roger.

Smith 37-866: attended by *Brachymyrmex heeri* Forel.

Trifidaphis phaseoli Pass—det. P. W. Mason

on lima beans at Cidra (I No. 6214).

Cerataphis lantaniae Boisduval
Anon 39-120: on vanilla.
on ? at Mayaguez (I No. 7294).

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COCCIDAE

Crypticerya sp., prob. **C. rosae** Riley & Howard
Wolcott (38-82: on casuarina at Ponce.
on casuarina at El Vigia, Ponce (42-36), at Guanica (308-39); on lignum-vitae at Guanica (49-37).

Icerya montserratensis Riley & Howard
Wolcott 35-143: outbreaks at Barceloneta and Isabela.
on casuarina at Mayaguez (131-40—det. J. A. Ramos).

page 120
Icerya purchasi Maskell (introduced) The Cottony Cushion Scale
Wolcott 35-143: spread to Vega Baja and Rio Piedras.
Wolcott 37-46: of but minor importance in 1934-35.
Wolcott 37-54: spread to Manatí (July), Humacao (October), and Arecibo (December) in 1935.
Wolcott 39-82: spread to Camuy (October 1936).
Wolcott 39-33: spread to Isabela and Mona Id.
Wolcott 39-508: successful establishment in P. R. of predator upon.
Wolcott, G. N. & Martorell, L. F., "Epidemics of Fungus Disease Control Insect Pests in Puerto Rico." Jour. Ec. Ent., **33**(1): 201-2. Menasha, Wis., February 1940: control by *Spicaria javanica* 100% effective in humid citrus groves.
[Wolcott, G. N., "The Dispersion of the Cottony Cushion Scale in Puerto Rico in Eight Years." Caribbean Forester, **2**(3): 132-5, map. New Orleans, La., April 1941.]
on rose at Bayamon (I No. 6297), at Aibonito (187-40); on Don Tomás, *Adenoropium multifidum* (L.) Pohl.—det. J. I. Otero, (181-32); on lime at Punta Las Marias, Santurce (21-40); on casuarina at Manati (54-35), on Trujillo Alto road (9-36) controlled by fungus, *Spicaria javanica,* at Arecibo (88-35), at Camuy (29-36), at Camp Guajataca, Ponce village, Isabela (1-38), on Mona Id. (125-39, 37-40), at Pennock's, Sabana Llana (55-39), at Camp El Verde, Rio Grande (370-40), at Mayaguez (130-40 det. J. A. Ramos), at Guanica (181-40); on gandúl, *Cajanus indicus,* at Isabela (34-37); on peppers, Mona Id. (125-39); on capá de obispo, *Acalypha wilkesiana* (109-40 J. S. Simons).

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Orthezia insignis Douglass
on poleo, *Lippia stoechadifolia,* at Ponce (I No. 6938); on *Chenopodium ambrosoides* det. J. I. Otero, at Arecibo (305-32); on *Iresine* at Aguas Buenas (I No. 7458); on *Chione venosa* at Bayamon (I No. 7155).

Lecaniodiaspis sp. nov.—det. H. Morrison
on *Inga vera* at Maunabo (73-37).

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Asterolecanium bambusae Boisduval
Anon 38-36: on many species of bamboo at Mayaguez.
Anon 39-52 & 53: on bamboo, illustration.
on bamboo at Villalba (409-40).

Asterolecanium militaris Boisduval
Anon 38-36: on three species of bamboo at Mayaguez, especially *Bambusa vulgaris*.
Anon 39-52 & 53: on bamboo, illustration.
Bartlett 39-493: "usually attacks leaves" of bamboo.

Asterolecanium pustulans Cockerell
Bartlett 39-493: on culms and larger branches of bamboo.
Martorell 40-31: on *Cassia siamea* Lam. and other hosts.
[Wolcott, G. N., "An Outbreak of the Scale Insect, *Asterolecanium pustalans* Cockerell on Magz, *Montezuma speciosissima*." Caribbean Forester, **2**(1): 6-7. New Orleans, La., October 1940.]

killing *Sciacassia siamea* (Lam.) Britton (5-34), at Toa Baja (45-37); on *Rapanea guianensis* at Dorado (I No. 7007); on *Taonabo stahlii* at Dorado (I No. 7008); on *Amygdalus persica* at Mayaguez (I No. 6094); on *Zanthoxylum flavum* (358-40 det. H. Morrison); on *Conocarpus erectus* at Boca de Cangrejos (375-40); causing leaves to wither and killing twigs and smaller lateral branches of maga, *Montezuma speciosissima*, at Isabela, Arecibo and Vega Alta (153-40, 373-40), at Cayey (378-40) and at Corozal (420-40).

Asterolecanium sp. nov.—det. H. Morrison
on maga at Vega Alta (I No. 6069).

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Ceroputo barberi Cockerell—det. H. Morrison
on *Foristiera* or *Mayepea* at Guanica Insular Forest (I No. 5929).

Phenacoccus gossypii Townsend & Cockerell
on *Malacha capitata* (I No. 6172), on *Ambrosia peruviana* (I No. 6176).

Pseudococcus brevipes Cockerell
Smith 37-838: attended by *Solenopsis geminata* F.
Smith 37-843: attended by *Pheidole megacephala* F.
Smith 37-845: attended by *Pheidole s. borinquenensis* Wheeler.
Smith 37-845: attended by *Crematogaster steinheili* Forel.
Smith 37-854: attended by *Wasmannia auropunctata* Roger.
Smith 37-866: attended by *Brachymyrmex heeri* Forel.

Smith 37-867: attended by *Prenolepis fulva* Mayr and *P. longicornis* Latreille.
Anon 38-98, Anon 39-106 & Bartlett 39-67 to 71: introduction of two parasites of, and recovery of one in P. R.
Fife 39-9: on cotton.

Pseudococcus adonidum L.
for "*Averrhoa carambola* L.," read *Barringtonia asiatica;* also on *Dracena fragrans* (23-35); an amaryllis, *Hippeastrum puniceum,* at Mayaguez (I No. 7419); on hibiscus (I No. 6365); on emejagua at Cayey (380-40).

Pseudococcus citri Risso
Smith 37-873: attended by *Myrmelachista ramulorum* Wheeler.
Fife 39-9: on cotton.
Wolcott 40-29: on maga

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Pseudococcus maritimus Ehrhorn
on chayote (I No. 6107).

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Pseudococcus nipae Maskell
Smith 37-845: attended by *Crematogaster steinheili* Forel.
Smith 37-873: attended by *Myrmelachista ramulorum* Wheeler.
Martorell 40-24: on anacaguitas, *Sterculia apetala.*
for "carambola tree," read, *Barringtonia asiatica;* also on avocado at Mayaguez (I No. 7418); on *Cenangium odoratum* at Dorado (I No. 4411); on *Sterculia apetala* at Guanica (76-40); on leaves of *Ficus lyrata* at Guayama (170-40); on *Callophyllum antillanum* at Guajataca (371-40); on laurél geo, *Ocotea portoricensis,* at Maricao (398-40); on laurél avispillo, (= geo) *Ocotea portoricensis,* at Ciales (419-40).

page 127
Trionymus sacchari Cockerell
Smith 37-854: attended by *Wasmannia auropunctata* Roger.
Smith 37-867: attended by *Prenolepis fulva* Mayr.
Wadley 37-103 to 113: on sugar-cane, especially POJ 2878, and sorghum.

page 128
Pseudococcus (Ferrisia) virgatus Cockerell
Smith 37-854: attended by *Wasmannia auropunctata* Roger.
Smith 37-866: attended by *Brachymyrmex heeri* Forel.
Fife 39-9: on cotton.
on *Melicocca bijuga* (I No. 6109).

Antonina (Chaetococcus) bambusae Maskell
Anon 38-36: on bamboo at Mayáguez.

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Pulvinaria psidii Maskell
on *Cedrella odorata* (341-39).

Pulvinaria urbicola Cockerell

on sea-grape (GNW—det. H. Morrison) at Pt. Cangrejos, 1921.

Ceroplastes denudatus Cockerell

Fife 39-9: on cotton.

on coconut palm, Puerta de Tierra (I No. 6114); formerly reported from the introduced African cloth bark tree, *Ficus nekbuda,* Muños Rivera Park, Puerta de Tierra (26-33), from which the present infestation on coconut palm presumably came.

Ceroplastes floridensis Comstock

on coconut palm (I No. 6110).

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Vinsonia stellifera Westwood

on *Garcinia* at Naguabo (I No. 7204).

Eucalymnatus tessallatus Signoret

on *Callophyllum antillanum* at Lares (359-40 det. H. Morrison).

Coccus accuminatus Signoret

on *Emelista tora* at Barceloneta (I No. 7160); on achiote at Salinas (I No. 6692).

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Coccus hesperidum Green

on leaves of mango at Fajardo (116-39 det. H. Morrison), at Mayaguez (I No. 5990).

Coccus viridis Green

Smith 37-832: attended by *Monomorium c. ebeninum* Forel.
Smith 37-845: attended by *Pheidole s. borinquenensis* Wheeler.
Smith 37-854: attended by *Wasmannia auropunctata* Roger.
Smith 37-866: attended by *Brachymyrmex heeri* Forel.
Smith 37-873: attended by *Myrmelachista ramulorum* Wheeler.
Anon 38-80: on *Chinchona* spp.
Fife 39-9: on cotton.

on *Randiae* at Arecibo (I No. 7430); attacking eggplant, almendra, *Coccolobis uvifera* and *C. laurifolia* on Mona Id. (110-39); on teak at Patillas (427-40).

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Saissetia nigra Nietner

Fife 39-9: on cotton.

on maga at Vega Alta (I No. 6069; tremendously abundant on *Ficus lentiginosa* at Ponce (38-36 det. H. Morrison).

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Saissetia oleae Bernard

Fife 39-9: on cotton.

on capá prieta, *Cerdana allidora,* at Salinas (8-40); on guava at San German (I No. 6183); on maga at Vega Alta

(I No. 6069), at Villalba (405-40); on almendra, Mona Id. (80-39); on *Sideroxylon foetidissimum* at Guanica (328-40); on *Cedrela mexicana* at Villalba (405-40); on *Tectona grandis* at Patillas (415-40); on *Zanthoxylum flavum* (358-40 det. H. Morrison).

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Howardia biclavis Comstock

on *Bixa orellana* at Bayamon (I No. 6204); on *Myrcia citrifolia* at Dorado (I No. 7026); on *Tecoma pentaphylla* at Vega Alta (I No. 7152); on *Genipa americana* at San German (I No. 6184, 6474); on *Cedrela odorata* at El Verde, Rio Grande (355-40 det. H. Morrison).

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Aulacaspis pentagona Targioni

Wolcott 37-45, Wolcott 37-57 and Wolcott 38-88: spraying experiments in attempted control on papaya.

Wolcott 39-36: best control found by Mr. L. A. Serrano of Isabela Sub-station to be high-power spraying with water.

Anon 38-80: on *Chinchona* spp.

Anon 38-98: parasites of, released in P. R.

Anon 39-100: fed to the lady-beetles, *Chilocorus cacti* L., introduced from Texas.

Anon 39-104: on *Calotropis gigantea.*

Martorell 40-31: on *Fraxinus.*

on garden pepper (I No. 6419); on geranium at Cayey (I No. 6509); on *Amygdalus persicae* at Mayaguez (I No. 6094); on *Fraxinus* sp. in Maricao Insular Forest (48-36 det. H. Morrison) and at Las Cruces (75-40), defoliating and killing trees; on *Solanum verbascifolium* at Camp Doña Juana, Villalba (357-40 det. H. Morrison); on *Erythrina glauca* at Villalba (356-40 det. H. Morrison).

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Pinnaspis (Hemichionaspis) minor Maskell

(as var. *strachani* Cooley) Fife 39-9: on cotton and *Thespesia populnea.*

Wolcott 40-29: on maga.

on emajagua at Cayey (381-40): on "achiotillo" at Quebradillas (416-40); on tung oil tree at Patillas (430-40); on *Zanthoxylum flavum* (358-40 det. H. Morrison).

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Aspidiotus (Aonidiella) cocotiphagus Marlatt

on tamarind (I No. 6106), at Arecibo (I No. 6075); on coconut (I No. 6110); on avocado (I No. 6148); on hibiscus (I No. 6353); on *Chalcas exotica* (I No. 7282); on *Jasminum sambac* (I No. 6197); on grape at Guaynabo (3-36 det. H. Morrison); on rose at Ponce (15-36 det. H. Morrison), at Bayamon (I No. 6297); on aceitillo, *Zanthoxylum flavum,* at Guanica Insular Forest (15-38 det. H. Morrison).

Aspidiotus destructor Signoret

Dohanian 37-243: "the coconut scale."

Anon 38-97: "notably reduced" by lady-beetles introduced from Trinidad.

Anon 39-106: host of *Azya trinitatis*.

on *Psidium guajava* (I No. 6171); on *Terminalia catappa* at Bayamon (I No. 6598), at Mayaguez (I No. 6386); on *Cocos nucifera* (I No. 6111, 6116), on Mona Id. (70-39); for "carambola tree" read *Barringtonia asiatica* (35-35 det. H. Morrison), also on this host on Mona Id. (71-39).

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Aspidiotus herculeanus Doane & Hadden—det. H. Morrison

on *Phoradendron randiae* at Arecibo (I No. 7431); on *Tabebuia* at Vega Alta (I No. 7152).

Aspidiotus sp.—det. H. Morrison

on *Myrcia citrifolia* at Palo Seco (I No. 6500).

Selenaspidus (Pseudaonidia) articulatus Morgan—The "W. I. Red" Scale of Citrus

on wild orange (7-39) defoliating tree, on which introduced lady-beetles from Trinidad, *Hyperaspis belloti*, were released; on kumquat at Mayaguez (I No. 6398); on *Malachra alceifolia* at Bayamon (I No. 6712); on *Thyella tamnifolia* at Manati (I No. 7140); on *Emelista tora* at Barceloneta (I No. 7160); on *Pothomorphe peltata* at Guaynabo (I No. 7174); on *Callophyllum antillanum* at Lares (359-40 det. H. Morrison).

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Chrysomphalus aonidium L.—the "Florida Red" Scale of Citrus

on *Taonabo stahlii* at Dorado (I No. 7008).

Chrysomphalus aurantii Maskell—the "California Red" Scale of Citrus

on lemon imported from California, at Trujillo Alto (14-36 det. H. Morrison) and on wild, unbudded citrus seedlings (33-37), on orange (I No. 6646), on kumquat (I No. 6647), on lemon (I No. 6648, 6649); on grapefruit at Bayamon (I No. 6099).

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Chrysomphalus dictyospermi Morgan

on rose at Bayamon (I No. 6297).

Chrysomphalus (Melanaspis) portoricensis Lindinger: Zeitschrift. f. Wissen., Insektbiol., Bd. VI, heft 12, p. 441, 1910 and Bd. VII, heft I, p. 9, 1911, TYPE from *Coccoloba excoriata* (= *venosa*), "Calambreña," at Cayay, P. R., near Las Cruces; possibly this sp., on sea-grape at Luquillo (702-40 det. H. Morrison).

Chrysomphalus sp.—det. H. Morrison
on *Coccolobis pyrifolia* at Maricao (360-40) leaves and branches heavily infested (not the above sp.).

Pseudischnaspis bowreyi Cockerell
on rose at Ponce (15-36 det. H. Morrison); on *Spondias purpurea* (I No. 6490).

page 141
Pseudoparlatoria ostreata Cockerell—the Grey Scale of Papaya
Wolcott 37-57, Wolcott 38-88: spraying experiments in attempted control on papaya.
Wolcott 39-36: Mr. L. A. Serrano of Isabela Sub-Station found most effective control to be high-power spraying with water.
Anon 39-100: fed to *Chilocorus cacti* L., lady-beetles imported from Texas.
on papaya on Mona Id. (38-40), at Bayamon (I No. 6147); on cultivated grape at Guaynabo (3-36 det. H. Morrison).

Pseudoparlatoria parlatorioides Comstock—det. H. Morrison
on leaves of *Laguncularia racemosa* at Faro de Cabo Rojo (55-37); on torchwood, *Amyris elemifera,* at Dorado (I No. 7210).

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Parlatoria pergandii Comstock
on kumquat at Barceloneta (I No. 6397).

Lepidosaphes gloverii Packard
on lime (I No. 7165).

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Ischnaspis longirostris Signoret
Martorell 40-24: on Honduras mahogany, *Swietenia macrophylla.*
on *Ficus nitida* on El Yunque (352-39, 363-40); on *Swietenia macrophylla* at Rio Grande (369-40).

ALEYRODIDAE

Aleurodicus griseus Dozier
on *Eugenia ludibunda* at Palo Seco (360-39).

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Leonardius lahillei Leonard
on mistletoe on *Ficus* at Ciales (6-36 det. H. L. Dozier); on mistletoe on *Inga vera* at Jajome Alto (52-37).

Bemisia inconspicua Quaintance—det. M. D. Leonard
on sweet-potato (48-38).

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Aleurotrachelus trachoides Back
on *Solanum torvum* at Isabela (39-36).

Aleurotrachelus sp. nov.—det. L. M. Russell
on leaves of sea-grape at Quebradillas (33-39, 42-38).

Tetraleurodes acaciae Quaintance ?—det. P. W. Mason
on *Meibomia supina* at Guaynabo (I No. 7166).

Tetraleurodes sp.—det. L. M. Russell
on sweet-potato leaves (I No. 7281).

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HEMIPTERA

Barber, H. G., "Insects of Puerto Rico and the Virgin Islands—Hemiptera-Heteroptera (excepting the Miridae and Corixidae)." Scientific Survey of Puerto Rico and the Virgin Islands, **14**(3): 263-441, fig. 36. New York Academy of Sciences, New York, July 7, 1939. "Since the manuscript of this article was completed before the receipt of the "Insectae borinquenses" of George N. Wolcott, all references to the species and other items of interest in that treatise are omitted."

CORIXIDAE

Arctocorixa sp.—det. H. G. Barber
Ramos Col., at Barranquitas xii-35, at Rio Piedras vi-12-32.

Centrocorisa kollari Fieber—det. H. B. Hungerford
AMC: at Mayaguez x-32.

BELOSTOMATIDAE

Cummings, Carl, "The Giant Water Bugs, Belostomidae—Hemiptera." Sci. Bul. Univ. Kansas, **21**(2): 197-219, pl. 2, Lawrence, March 1933.

Belostoma boscii Lepeletier & Serville
Barber 39-425: with *B.* (*Zaitha*) *anura* in synonymy, at Mayaguez, Cayey and Coamo.

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Belostoma minor Duf.—det. H. G. Barber
Ramos Col., at Guanica Lagoon, i-11-36.

Lethocerus annulipes Herrich-Schaeffer
Cummings 33-203: collected by E. A. Waggerin.
Barber 39-426: at Ponce and Mayaguez.

Lethocerus del-pontei De Carlo
Cummings 33-206: at San Juan.
Barber 39-426: one specimen in USNM from Puerto Rico.

NEPIDAE

for "**Ranatra australis** Hungerford" and "sp.," read
Ranatra insulata Barber 39-423: TYPE from Las Marias, P. R., illustration.

NAUCORIDAE

Pelocoris femorata P. B.
Barber 39-422: at Guanica and Desengaño.

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NOTONECTIDAE

Buenoa femoralis Fieber (as *Anisops*) *in* "Rhynchota" 59, (1851): TYPE from P. R.
Barber 39-420: from San Juan, Coamo, Quebradillas, and Mona Id. (Lutz).

Buenoa macropthalma Fieber (not *B. macrophthalmus*)
Barber 39-420: from five P. R. localities.

Buenoa pallipes F.
Barber 39-241: from Mona and Culebra Ids., Coamo, Aibonito and Aguadilla.

Notonecta indica L.
Hungerford, H. B., "The Genus *Notonecta* of the World, Notonectidae—Hemiptera." Sci. Bul. Univ. Kansas, **21**(1):5-195, pl. 17. Lawrence, March 1933: p. 117, from Desengaño, P. R., June 1924 (Cornell Univ. lot 719).
AMC: at Mayaguez xii-34 det. Hungerford.
Barber 39-419: with *N. undulata* in synonymy, six P. R. localities.
all records as "*N. undulata*" and "*N.* sp." go here.

PLEIDAE

Plea punctifer Barber
Barber 39-418: illustration.

Plea puella Barber
(as *Plea striola* Fieber) Wetmore 16-35, 75: eaten by Gallinule and Black Swift.
Barber 39-417: illustration.

SALDIDAE

Pentacora signoreti Guerin—det. H. B. Hungerford
AMC: at Boqueron vii-32, Mayaguez i-35, Arecibo iii-35.
around brackish pools, on beach at Maunabo (10-40 det. H. G. Barber).

Pentacora sphacelata Uhler
Barber 39-415: "Porto Rico near shore (no other data)—A. M. N. H."

Saldula pallipes F.
Barber 39-415: at Ensenada.

Micracanthia humilis Say ? (not *Micranthia*)
Barber 39-417: "a single male specimen from San Juan."

Micracanthia sulcata Barber 39-415: TYPE from Coamo Springs, P. R., other from Ciales. Illustration.
the record "on weeds from Ciales (649-21)" goes here.

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VELIIDAE

Microvelia capitata Guerin
Barber 39-411: with *M. albonotata* Champion in synonymy.
(as "sp.") Wetmore 16-40, 41: eaten by Killdeer and Spotted Sandpiper.
the records of *M. albonotata* go here, also, on surface of water (250-16), at light (203-11); at Guanica (EGS).

Microvelia paludicola Champion
Barber 39-413: at Coamo, Adjuntas and Ponce.

Microvelia pulchella Westwood
Barber 39-410: at Coamo and Aibonito.

Microvelia robusta Uhler
Barber 39-411: on Mona Id. and at six P. R. localities.

Rhagovelia collaris Burmeister
(as *R. tayloriella* Kirkaldy) Barber 23-13 listed.
(as *R. angustipes* Uhler) AMNH at Naguabo and Maricao.
Barber 39-413; synonymy, at thirteen P. R. localities.
on El Yunque (95-35 det. H. G. Barber).

GERRIDAE

Limnogonus franciscanus Stal
(as *Tenagogonus (Limnometra) quadrilineatus* Champion) Van Zwaluwenburg's list: det. O. Heidemann.
(as *Gerris marginatus* Guerin) Stahl. Wetmore 16-22: eaten by Cuban Green Heron.
(as *Limnotrechus marginatus* Guerin) Gundlach.
(as *Tenagogonus (Limnogonus) guerini* Lethierry & Severin) Barber 23-13: listed.
(as *Gerris guerini* Lethierry & Severin) AMC collections.
(as *Limnogonus marginatus* Guerin) AMNH and AMC collections.
Drake, C. J. & Harris H. M., "Notes on some North American Gerrids (Hemiptera)." Arkiv. Zool., **28** B (1 No. 2): 1-4, fig. 1. Stockholm, 1935: synonymy.
Barber 39-407: from Vieques, Culebra and Mona Ids., and twelve P. R. records.
in water in ditch (712-16); at light at Guanica (614-13); in cistern, Mona Id. (74-39) and in pools (207-40 det. H. G. Barber).

Gerris cariniventris Champion
Barber 39-409: at Maricao and Barros.

Gerris remigis Say
Barber 39-408: at Quebradillas.
presumably here goes also the "sp. nov.", in water at Ponce (I No. 5738).

Rheumatobates imitator Uhler
Barber 39-407: from Guayabál Reservoir (Hildebrand).

Metrobates laudatus Drake, C. J. & Harris, H. M., Revista Entomologia, 7 ( ): Rio de Janeiro, 1937: TYPE ? from Juana Diaz and Rio Piedras, P. R.

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HYDROMETRIDAE

Hydrometra consimilis Barber
Barber 39-406: at Añasco.

CRYPTOSTEMMATIDAE

Ceratocombus vagans McAtee & Malloch
Barber 39-405: at Rio Piedras and Jayuya.
here goes the "*C. minutus* Uhler—det. H. G. Barber on dead leaves (I No. 5907)."

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MIRIDAE

Paracarnus cubanus Bruner—det. H. G. Barber
abundant on underside of leaves of *Fraxinus* sp. (ash) at El Verde, Rio Grande, and of *Cordia sulcata,* morál, and of emejagua, *Pariti tiliaceum,* there and at Cayey (352-40).

Hyaloides vitreus Distant
Wolcott 40-29: on maga.

Lygus apicalis Fieber
Fife 39-9: on cotton.
at light, Mona Id. (377-39 det. H. G. Barber).

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Polymerus cuneatus Distant
on sugar-cane at Salinas (258-39).

Creontiades rubrinervis Stal
Fife 39-8: on cotton.

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ANTHOCORIDAE

Paratriphleps pallidus Reuter
Barber 39-404: at San Juan. Illustration.

Orius insidiosus Say
Barber 39-403: many records.

Asthenidea picta Uhler
Barber 39-402: no new records.

Xylocoris sordidus Reuter
(as *Piezostethus*) Barber 23-13: listed.
Barber 39-401: from Mona Id. (Lutz).

Cardiastethus rugicollis Champion
(as *C. assimilis* Reuter) Dozier 27-280: on *Ficus nitida*, predaceous on thrips.
Barber 39-402:
on papaya at Arecibo (I No. 4678).

Macrotracheliella laevis Champion
Barber 39-403:

Macrotracheliella nigra Parshley
Barber 39-403: possibly a misidentification.

Lasiochilus divisus Champion
Barber 39-401: from Vieques Id.

Lasiochilus microps Champion ?
Barber 39-401: ?
presumably this is "*L. fusculus* Reuter—det. H. G. Barber, on decayed flower stalk of banana at Bayamon (I No. 2444 Leonard 33-132)."

Lasiochilus pallidulus Reuter
Barber 39-400: from Vieques Id. (Leonard).

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POLYCTENIDAE

Hesperoctenes fumarius Westwood
Barber 39-399: on bat from Vieques Id. (Busck).

CIMICIDAE

Cimex hemipterus F.
Riley, W. A. & Johannsen, O. A., "Medical Entomology," 1932, p. 157: presence in P. R.
Barber 39-398: many records.
on Mona Id. (75-39).

NABIDAE

Metatropiphorus drakei Harris, Halbert M., "A Monographic Study of the Hemipterous Family Nabidae as it occurs in North America." Entomologica America, **9** (1 & 2): 1-90, pl. 4, 1928: p. 73, TYPE from Utuado, P. R.
Barber 39-395: not seen.

Neogorpis neotropicalis Barber
Harris 28-83:
Barber 39-396: no new records, illustration.

Carthasis gracilis Harris
Barber 39-396: with *C. minor* Reuter in synonymy, at Aibonito, Aguirre (Box) and Rio Piedras.
(4-25).

Nabis capsiformis Germar—det. H. G. Barber
Fife 39-9: on cotton.
on string beans at Loiza (I No. 6781).

Nabis spinicrus Reuter
Barber 39-395: with *N. signatus* in synonymy, at Aibonito.

Nabis sordidus Reuter
Barber 39-395: at San Juan, Coamo and Tallaboa.

Pagasa fusca Stein
Barber 39-394: from Coamo Springs.

MESOVELIIDAE

Mesovelia mulsanti caraiba Jaczewski
Barber 39-393: at seven P. R. localities.
on lily pond (I No. 7180).

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REDUVIIDAE

Heza pulchripes Stal, Oefv. Vet.—Akad. Forh., 1859: p. 199, TYPE from P. R.
Barber 39-389: "apparently confined to P. R."

Heza angulifer Barber 39-389: TYPE from Bayamon, P. R., others from Ponce and Mayaguez. Illustration.
here belongs "*Heza* sp. nov.—det. H. G. Barber on Crotalaria at Mayaguez (I No. 5816.)"

Stenopoda cinerea Laporte
Stahl. (as *S. culiciformis* F.) Gundlach.
Barber 39-388: synonymy.
AMC: at Luquillo vi-32, Coamo i-32, Mayaguez ix-30, v-31. (284-12), at light (137-32).

Narvesus caolinensis Stal—det. H. G. Barber
AMC: at Luquillo vi-32.

Pnirontis infirma Stal
Barber 39-388: at Isabela (Leonard).
on flowers of Amaranthus (506-16 det. H. G. Barber).

Perigrinator biannulipes Montrouzier
Plank 39-151: records from P. R.

Zelus longipes L.
Barber 39-391: "convinced that Champion was correct in stating in reference to *Z. rubidus* 'perhaps not really distinct from *Z. longipes* L.' "
Fife 39-9: on cotton.

page 159 all the records of *Z. rubidus* should come here, as well as that of "(as "sp.") Wetmore 16-61, 77, 80: eaten by Ani, Kingbird and Petchary.", together with the following new records:

feeding on *Cycloneda sanguinea,* Mona Id. (101-39); on flowers of *Borreria verticillata* at Yabucoa (318-39); on flowers of *Heliotropum indicum,* Vieques Id. (103-40).

Zelus subimpressus Stal
Barber 39-392: at six P. R. localities.
on guava (493-16 det. H. G. Barber); all stages at Vega Alta (219-17 det. H. G. Barber).

Zelus nugax Stal
Barber 39-392: "should be referred to *Leptocoris filiformis* Fabricius."

Rasahus biguttatus Say
Barber 39-389: Danforth's and Cotton's collections.
(as *R. hamatus* F.—det. H. G. Barber) AMC: at Yabucoa vii-20.
on grapefruit tree (560-17).

Ploiaria gundlachi Dohrn
Barber 39-387: at Mayaguez, Coamo and Isabela.

Empicoris barberi McAtee & Malloch (not *Empicornis*)
Barber 39-386: generic transfer from *Ploiarodes.*
at light (I No. 5591, det. H. G. Barber as *E. subparallelus* McAtee & Malloch).

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Empicoris armatus Champion
Barber 39-387: at Aibonito and from Vieques Id. (Leonard).
on foliage of grapefruit at Vega Alta (222-17 det. W. L. McAtee as *Ploiarodes armatus*).

Empicoris rubromaculata Blackburn
Barber 39-386: generic transfer from *Ploiarodes,* the records in IP-243 and IB-160 under this generic name, and from Vieques Id. (Leonard).

Emesopsis nubilis Uhler
Barber 39-386: from Vieques Id. (Leonard).
under dead leaves (I No. 6000).

Ghilianella longula McAtee, W. L. & Malloch, J. R., "Revision of the American Bugs of the Reduviid Subfamily Ploiarinae." No. 2573. Proc. U. S. Nat. Mus., **67**(1): 1-153, pl. 9. Washington, 1925: TYPE from Cuba.
Barber 39-388: from El Yunque (Leonard).

Ghilianella varicornis Dohrn
McAtee & Malloch 25-96 & 101: female described.
Barber 39-387: listed.

Emesa tenerrima Dohrn
Barber 39-387: noting McAtee & Malloch 25-46, generic transfer from *Westermannia.*

ENICOCEPHALIDAE

Enicocephalus semirufus Barber 39-382: TYPE from Adjuntas, P. R., other from Yauco. Illustration.

PHYMATIDAE

Phymata marginata F.
Barber 39-373: Gundlach's record as *P. erosa* in synonymy, eight other P. R. records.

Macrocephalus crassimanus F.
Barber 39-378: seven P. R. records.
on *Inga laurina* at Lares (155-22 det. W. L. McAtee as *M. bergrothi* Handl.).

page 161
Macrocephalus leucographus Westwood
Barber 39-379: re-determinations.
on coffee at Lares (287-21 det. W. L. McAtee as *M. granulatus* Champion); on *Inga laurina* at Adjuntas (I No. 3872 det. as "sp. nov.").

Macrocephalus pulchellus Westwood
Barber 39-379: not seen in P. R.

Macrocephalus productus Barber 39-376: TYPE from Aibonito, P. R., illustration.

Macrocephalus spiculissimus Barber 39-374: TYPE from Aibonito, P. R., illustration.
a very spiny nymph from leaves of *Inga vera* (80-23 det. GNW, confirmed H. G. Barber).

Extraneza nasuta Barber 39-380: TYPE from Yauco, P. R., Illustration.
on ? at Yauco (I No. 5767 det. as "*Macrocephalus* sp. nov.").

TINGITIDAE

Leptopharsa illudens Drake = *Atheas pallidus* Barber 23-6: TYPE from P. R.
Barber 39-370: at Arecibo and Mayaguez.

Corythucha gossypii F. (not *Corythuca*)
Anon 38-86 & Anon 39-123: negative results in experiments used as vector of bunchy-top disease of papaya.
Fife 39-9; on cotton.
Barber 39-368: description and economic summary.
Martorell 40-23: on aceitillo, *Zanthoxylum flavum;* carubio, *Z. monophyllum;* and espino rubiál, *Z. caribaeum.*

on castor bean, Mona Id. (172-39 det. H. G. Barber, 31-40); on *Ichthyomethia pispicula* and castor bean, Vieques Id. (101-40); on *Capparis baducca* at Guanica (345-40).

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Corythaica carinata Uhler

Barber 39-369: four P. R. records.

Fife 39-9: on cotton.

Corythaica planaris Uhler

Barber 39-369: all over P. R. on eggplant and *Solanum torvum*.

on eggplant (I No. 6331).

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Monanthia c-nigrum Champion

Barber 39-372: only Danforth's record from Joyuda.

Monanthia monotropidia Stal

Barber 39-371: at Aibonito and Arecibo.

Martorell 40-23: heavy investations on capá prieto, *Cerdana alliodora* R. & P. (= *Cordia Gerascanthus* Jacq.), at Cayey and Salinas.

all stages abundant on underside of leaves of capá prieto at Cayey (90-40), presumably on this host in mountains north of Yauco (266-22).

Teleonemia sacchari F.

Barber 39-371: with previous records of *T. prolixa* Stal from P. R. in synonymy, nine new P. R. records.

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Leptodictya bambusae Drake

Barber 39-370: also in Haiti.

PYRRHOCORIDAE

Dysdercus andreae L.

Barber 39-366: from Culebra and Mona Ids., many P. R. records.

Fife 39-7: on *Thespesia populnea, Abutilon hirtum, Sida* sp. and cotton.

Wolcott 40-30: feeding on seeds of maga.

Dysdercus sanguinarius Stal

Barber 39-366: six P. R. records.

Fife 39-7: on cotton, maga and *Thespesia populnea*.

on *Sterculia apetala* at Mayaguez (I No. 7224).

Dysdercus suturellus Herrich-Schaeffer

Barber 39-366: Ballou's 1906 record.

Largus obovatus Barber

Barber 39-164: generic transfer from *Euryophthalmus*, and with P. R. record of *Largus rufipennis* Castelnau and *L. varians* Stal in synonymy. Illustration.

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LYGAEIDAE

Oncopeltus aulicus F.
Barber 39-336: from Culebra Id. (Busck).
Fife 39-9: on cotton.
on Mona Id. (15-37 det. H. G. Barber, 98-39), on blossoms of *Colubrina colubrina, Moringa moringa* and *Pisonia albida* (206-40 det. H. S. Barber).

Oncopeltus fasciatus Dallas
Barber 39-325: many P. R. records.
on milkweeds at Vega Baja (I No. 7449).

Lygaeus albonotatus Barber
Barber 39-337: illustration.

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Lygaeus coccineus Barber
Barber 39-338: illustration.

Lygaeus collaris F.
Barber 39-337: at seven P. R. localities.
Fife 39-9: on cotton.
here should go all records of *Lygaeus bicrucis* Say, also the new records: at Aguadilla (22-40); on blossoms of *Pisonia albida,* Mona Id. (248-40).

Lygaeus pulchellus F.
Barber 39-336: from Mona Id.
abundant and mating on *Corchorus hirsutus* at Pt. Cangrejos (79-16 det. H. G. Barber).

Ortholomus jamaicensis Dallas
Barber 39-340: many P. R. records, Vieques Id. (Busck).

Nysius ericae Schilling
Barber 39-342: from Mona Id., Caguas and Adjuntas.

Nysius inaequalis Uhler
Barber 39-341: with *N. basalis* in synonymy, from Desecheo and Mona Ids. (Crampton).

Nysius strigosus Uhler
Barber 39-342: at Tallaboa and from Mona Id. (Lutz).

Cymoninus notabilis Distant (not *Cymonius*)
Barber 39-344: at Caguas, Coamo and Añasco.

Ischnorhynchus championi Distant
Barber 39-344: many P. R. records, from Mona Id. (Crampton).

Cymus virescens F.
Barber 39-343: at Aguirre, Ponce, Añasco and Santurce. Illustion.

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Ischnodemus sallei Signoret
Barber 39-345: Danforth's records.

Blissus leucopterus Say
(as var. *insularis* Barber) Wadley 37-107: on grass.
Anon 37-93: attacking *Polytrias amaura,* a Java grass at Mayaguez.
Barber 39-345: from Mona Id. (Crampton).
killing out extensive patches of malojillo grass as Manatí (266-39); on young sugar-cane at Canovanas (50-37); on grass, Mona Id. (99-39).

Geocoris thoracicus Fieber
Barber 39-346: with previous P. R. records as *G. lividipennis* in synonymy, at San Juan and Ensenada.
at Faro de Cabo Rojo viii-36 (J. A. Ramos).

Ninyas deficiens Lethierry
Barber 39-346: at Aibonito and Adjuntas.

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Clerada apicornis Signoret
Barber: 39-363: cosmopolitan.

Paragonatas divergens Distant
Barber 39-363: at Lares (Sein).

Ligyrocoris abdominalis Guérin
Barber 39-350: at Tallaboa.

Ligyrocoris litigiosa Stal
Barber 39-350: at Bayamon (Busck).

Paromius longulus Dallas
Barber 39-350: at many P. R. localities, Mona and Desecheo Ids.

Pachybrachius bilobatus Say
(as *Orthaea*) Fife 39-9: on cotton.
Barber 39-353: generic transfer from *Orthaea;* at many P. R. localities, also Vieques Id.

Pachybrachius intermedius Barber
Barber 39-353: generic transfer from *Orthaea;* at Cataño and Isabela, illustration.

Pachybrachius scutellatus Dallas—det. H. G. Barber
Ramos Col., at Mayaguez v-22-40.

Pachybrachius servillei Guérin
Barber 39-354: at Humacao.

Pachybrachius vinctus Say
Barber 39-353: many P. R. records, also Mona and Vieques Ids.

Heraeus guttatus Dallas
Barber 39-354: at light at Isabela (Leonard).

Exptochiomera minima Guérin
Barber 39-355: generic transfer from *Ptochiomera;* at Ensenáda, Adjuntas, Aguirre and San German.

Pachygrontha bimaculata Distant
Barber 39-347: from Mayaguez (Danforth).

Pachygrontha parvula Barber
Barber 39-348: a single male from Mona Id.

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Ozophora atropicta Barber 39-356: TYPE from Manatí, P. R., others from five P. R. localities, the Bahamas and Hispaniola.
on grass at Bayamon (I No. 5464 det. as "sp. nov.").

Ozophora burmeisteri Guérin
Barber 39-355: at four P. R. localities.

Ozophora pallescens Distant
Barber 39-361: at San Juan, Dorado, Guayama, El Yunque and from Vieques Id.
at light (251-16 det. W. L. McAtee); at light at Palo Seco (I No. 6565).

Ozophora quinquemaculata Barber 39-359: TYPE from Vieques Id., others from six P. R. localities; previously reported as *O. concava* Distant. Illustration.

Ozophora subimpicta Barber 39-358: TYPE from Mayaguez, P. R., others from El Yunque, Aibonito and Adjuntas, also from Hispaniola. Illustration.

NEIDIDAE

Jalysus reductus Barber 39-331: TYPE from Mona Id., others from Hispaniola, Mexico and Central America. Illustration. Previously listed from P. R. as *J. spinosus* Say.

ARADIDAE

Mezira abdominalis Stal
Barber 39-330: at Mayaguez (Landrón).

Aneurus minutus Bergroth
Barber 39-330: from Adjuntas.
in decaying wood at Adjuntas (I No. 5491 det. as *A. politus* Say by HGB); nymph in dead leaves (I No. 5909).

COREIDAE

Leptoglossus balteatus L.
Barber 39-311: at Guanica.

Leptoglossus gonagra F.
Barber 39-310: common in P. R.
on *Lantana* at Guajataca (273-39); on *Borreria verticillata* at Aguadilla (283-39).

page 170
Leptoglossus stigma Herbst
Barber 39-311: "chief food-plant apparently guava."
on guava at Sabana Grande (84-37).

Phthia picta Drury
Barber 39-312: from Culebra Id. (Busck).
on eggplant, Mona Id. (102-39).

? **Phthia rubropicta** Westwood
Barber 39-312: distinct from *P. lunata*, which is continental, but under which West Indian records have been given.

Spartocera batatas F.
Barber 39-314: illustration.

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Spartocera fusca Thunberg
Barber 39-313: many records.

Sephina erythromelaena White
Barber 39-316: re-determination of *S. indierae* Wolcott as identical with this continental species.

Chariesterus gracilicornis Stal
Barber 39-316: all *C. moestus* records from P. R. are this species.
Fife 39-9: on cotton.

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Althos obscurator F.
Barber 39-318: generic transfer from *Margus*, specimens from Aibonito.

Catorhintha guttula F.
Barber 39-318: from Vieques Id. (Busck) and Mona Id.
Fife 39-9: on cotton.

Catorhintha borinquensis Barber
Barber 39-319: illustration.

Anasa scorbutica F.
Barber 39-320: injurious to Curcurbitaceae.
on squash at Morovis (I No. 7397).

Zicca taeniola Dallas
Barber 39-320:

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Sphictyrtus whitei Guérin

Barber 39-321: illustration.

common on Mona Id. (97-39, 30-40) adults in swarms clinging to lower branches of trees in shade of cliff, no apparent preference as to kind of tree, and not feeding. At top of cliff, adults on tender leaves of *Coccolobis laurifolia,* possibly feeding (GNW).

Leptocorixa filiformis F. (not *Leptocoris*)

Fife 39-9: on cotton.

Barber 39-324: five P. R. records.

Barber 39-392: "*Zelus nugax* Stal, recorded by Wolcott from Porto Rico, should be referred to *Leptocorixa filiformis* Fabricius."

the records of *Zelus nugax* (IB-159) should thus come here, also: on Mona Id. (159-39).

Hyalmenus longispinus Stal

Barber 39-323: from Mona Id.

Megalotomus rufipes Westwood

Barber 39-323: many records.

Fife 39-9: on cotton.

Harmostes affinis Dallas

Barber 39-326: from Aguirre (Box).

Harmostes serratus F.

Barber 39-325: many records.

Exogenus extensum Distant (not *extensus*)

Barber 39-326: from San Juan.

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Corizus hyalinus F.

Barber 39-327: from Mona Id. (Lutz) and Vieques Id. (Busck).

Fife 39-9: on cotton.

on weeds at Mayaguez (I No. 5943).

Corizus sidae F. (with "? prob. *vincentii* Westw." penciled in by HGB)

Barber 39-327: from Mona and Desecheo Ids. (Lutz) and Vieques and Culebra Ids. (Busck).

Fife 39-9: on cotton.

Jadera rubrofusca Barber

Barber 39-328: all P. R. records of *Jadera* refer to *rubrofusca*; illustration, from *Scirpus validus* at Ponce (Oakley) and from Culebra Id. (Wheeler).

nymphs on *Serjania polyphylla* at Barceloneta (I No. 7162).

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PENTATOMIDAE

Megaris is a genus of the Scutelleridae and should be on p. 182.

Mormidea angustata Stal
Barber 39-288: from Mona Id.

Mormidea cubrosa Dallas
Barber 39-287: with *M. sordidula* Stal in synonymy.
Fife 39-9: on cotton.

Solubea insularis Stal
Barber 39-289: at Mayaguez (Danforth).

Solubea pugnax F.
Barber 39-288: at Coamo.

Euschistus acuminatus Walker
Barber 39-289: illustration.

Euschistus fiifibulus P. B.
Barber 39-290: many records.
on tobacco at Utuado (12-38).

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Euschistus crenator F.
Barber 39-291: from Culebra Id.

Proxys victor F.
Barber 39-291: Gundlach's record of *P. punctulatus* may be a misidentification.

Thyanta antiguensis Westwood
Barber 39-293:
on sugar-cane at Salinas (294-39).

Thyanta casta Stal
Barber 39-293: from Vieques Id., Aguirre, Coamo and Ensenada.

Thyanta perditor F.
Barber 39-292: from Mona Id.
Fife 39-9: on cotton.

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Loxa pilipes Horvath, *in* Ann. Mus. Nat. Hungary, **22:** 318, pl. 5, fig. 5, 1925: TYPE from P. R.
Barber 39-294: with *Loxa flavicollis* in synonymy; from Coamo Springs, El Yunque and Lares.
AMC: at Mayaguez x-37, det. H. G. Barber.

Loxa planifrons Barber & Bruner
Barber 39-294:

Fecelia minor Vollenhoven, *in* Verd. Akad. Amst. Nat. **2**(2): 178, (1868): TYPE from P. R.
Barber 39-294: at nine P. R. localities.
apparently puncturing grapefruit, at Las Marias (I No. 5941).

Fecelia sp. nov.—det. H. G. Barber
AMC: at Mayaguez viii-37, x-37.

Runibia perspicua F.
AMC: on Vieques Id. xii-35 det. H. G. Barber.
Barber 39-295: no P. R. record.

Vulsiera violacea F.
Barber 39-295: only Oakley's specimen from Ponce.

Nezara viridula L.
Wolcott 37-82: in pellet of toad excrement.
Anon 38-86 & Anon 39-128: negative as vector in bunchy-top disease of papaya experiments.
Barber 39-296: cosmopolitan.

Fife 39-8: on cotton.
on Mona Id. (96-39, 267-40); injurious to tobacco at Utuado (11-38).

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Acrosternum marginatum P. B.
Barber 39-296: TYPE from Hispaniola.
Fife 39-8: on cotton.
on Mona Id. (118-39).

? **Banasa herbacea** Stal
Barber 39-297: at Santurce, Ensenada and from Vieques Id.

Banasa humeralis Barber 39-297: TYPE from San German, P. R., illustration.
AMC: (as "sp. nov." det. H. G. Barber) at Luquillo vii-32 and Añasco xii-35.

Piezodorus guildinii Westwood (not *guildingi*)
Barber 39-299: many records.
Fife 39-8: on cotton.

Piezodorus tinctus Distant
Barber 39-299: from Aibonito.

Arvelius albopunctatus DeGeer
Barber 39-300: many records.
on pepper at Vega Baja (I No. 7390); apparently feeding on immature eggplant fruits, at Mayaguez (I No. 5942); on Mona Id. (95-39).

Brepholoxa rotundifrons Barber 39-300: PARATYPE from Ensenada, P. R., illustration.

Edessa cornuta Burmeister
Barber 39-302: with *E. bifida* in synonymy, many P. R. records.
on sugar-cane at Quebradillas (224-39).

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Edessa parvinula Barber
Barber 39-302: illustration.

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Alcaeorrhynchus phymatophorus P. B.
Barber 39-303: with *Mutyca grandis* Dallas in synonymy; at Cayey.
on palo verde, *Parkinsonia aculeata,* at Faro de Cabo Rojo (60-37 det. H. G. Barber).

Pharypia pulchella Drury
Barber 39-295: at Mayaguez.

Andrallus spinidens F.—det. H. G. Barber
in cane field at Guanica (70-37).

Podisus borinquensis Barber 39-305: TYPE from Ponce, P. R., others from Rio Piedras, illustration.
These are the specimens referred to as "*Podisus sculptus* Champion—det. W. L. McAtee, on coffee leaves (726-17)" and "*Podisus* sp. nov.—det. H. G. Barber, on weeds at Ponce (I No. 4629)."

Podisus mucronatus Uhler
Barber 39-304: at Guanica (Dozier).

Podisus sagitta F.
Barber 39-304: many records.
Fife 39-8: on cotton.

Piezosternum subulatum Thunberg
Barber 39-307: many records.
nymph on vine at Mayaguez (I No. 7380).

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CYDNIDAE

Allocoris minuta Uhler
Barber 39-269: generic transfer (after McAtee & Malloch) from *Corimelaena* and *Eucoria.* At five P. R. localities.

Aethus communis Uhler
Barber 39-271: at Bayamon (Busck).

Aethus indentatus Uhler
Barber 39-272:

Geocnethus reversus Barber & Bruner
Barber 39-272: no new records.

Amnestus diminuatus Barber 39-274: TYPE from Adjuntas, P. R., on coffee. Illustration.

Amnestus pusio Stal
Barber 39-274: "often confused with *A. pusillus* Uhler." From Vieques Id.
at light at Isabela (180-31 det. H. G. Barber), at Guajataca (74-38, 13-40).

Amnestus subferrugineus Westwood
Barber 39-273: from Adjuntas and Cayey.

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SCUTELLERIDAE

Pachycoris fabricii L.
Barber 39-282: "There is only one species in Porto Rico."
All the records under *P. torridus* Scop. are this species, also: resting on sugar-cane at Isabela (255-39); on ?, Mona Id. (99-39); adults and eggs on *Cordia nitida* at Maricao (388-40).

Megaris puertoricensis Barber 39-283: TYPE from Aibonito, P. R., on *Eugenia* ? (Oakley). Illustration.

Tetyra antillarum Kirkaldy
Barber 39-282: at Guanica (Smyth).
at light at Guanica (1097-13).

Diolcus boscii F.
Barber 39-280: "not yet discovered in Porto Rico."

Diolcus disjunctus Barber 39-281: TYPE from Ponce, P. R., others from Mayaguez and Rio Piedras. Illustration.
at Salinas (373-39).

Diolcus irroratus F.
Barber 39-280: many P. R. records, also from Culebra Id.
Fife 39-9: on cotton.

Symphylus caribbeanus Kirkaldy
Barber 39-278: with Gundalch's record of *Mesotrypa sinuosa* Uhler MS in synonymy: at Ponce (Oakley).

Sphyrocoris obliquus Germar
Barber 39-278: Gundlach's record.

Augocoris illustris F.
Barber 39-278: with Gundlach's record of *A. sexpunctatus* F. in synonymy; at Mayaguez (Danforth).

Geotomus spinolai Signoret
Ramos Col., at light at Humacao iii-18-40.

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COLEOPTERA

CICINDELIDAE

Tetracha sobrina Dejean, var. **infuscata** Mannerheim
Wolcott 37-82: in pellet of toad excrement.

page 185
Cicindela boöps Dejean
thousands around salt pools, Faro de Cabo Rojo (58-37).

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Cicindela trifasciata F.
on beach of salt lagoons at Ensenada (37-36); at window of new Station building (230-39); in sandy cane fields at Yabucoa (236-39).

CABARIDAE

Darlington, Jr., P. J., "West Indian Carabidae II." Psyche, **42**(4): 167-215. Cambridge, 1935.
"West Indian Carabidae V, new forms from the Dominican Republic and Puerto Rico." Mem. Soc. Cubana de Historia Natural, **13**(2): 79-101. Habana, April 1939.

Scarites mutchleri Bänn
Darlington 39-81: with *S. montanus* Mutchler in synonymy.

Scarites danforthi Darlington 39-80: TYPE from Maricao Forest, at 3,000 ft., P. R.

Oxydrepanus coamensis Mutchler
Darlington 39-84: generic transfer from *Dyschirius;* collected on El Yunque.

Clivinia limbipennis Duval—det. P. J. Darlington.
AMC: at Cabo Rojo xii-31.

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Aspidiglossa aerata Putzeys—det. P. J. Darlington
AMC: at Mayaguez v-36.

Bembidion portoricense Darlington 39-86: TYPE from El Yunque, P. R.
AMC: paratypes from El Yunque v-38.

Bembidion viridicolle Laferte = *B. chevrolati* C. & H.
Ramos Col.: at Ensenada i-37—det. P. J. Darlington.

Tachys corruscus Leconte—det. P. J. Darlington
Ramos Col.: at Mayaguez viii-32, Añasco ii-37.

Tachys carib ?
Darlington 35-176: TYPE from Haiti, also in P. R.
Ramos Col.: at Mayaguez iii-36.

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Galerita microcostata Darlington
(597-16 det. P. J. Darlington).

Lebia marginicollis Dejean—det. P. J. Darlington
(252-12, 645-17 det. P. J. Darlington).

Apenes marginalis Dejean
the "as sp." records are this, det. P. J. Darlington.

Apenes pallipes F.—det. P. J. Darlington
Ramos Col.: at Mayaguez vi-31, ix-31.
(I No. 6167).

Apenes portoricensis Darlington 39-100: TYPE from Guanica Lagoon, P. R.

Perileptus dentifer Darlington 35-177: TYPE from Haiti, also in Puerto Rico.
AMC: in river gravel at Mayaguez iii-36.

Pentagonica picipes Darlington 35-212: TYPE from Jamaica, also in Puerto Rico.
Ramos Col.: at Mayaguez xii-36, Luquillo vi-32.

Brachinus brunneus Castelnau
at light at Guanica (377-13 det. A. J. Mutchler).

Loxandrus celeris Dejean—det. P. J. Darlington
Ramos Col.: at Guanica Lagoon i-36.

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Phloeoxena portoricensis Darlington 39-99: TYPE from El Yunque, others from Maricao, P. R.
Ramos Col.: paratypes from El Yunque v-38.

Selenophorus alternans Dejean
at light (I No. 6051), at Guanica (574-13 det. A. J. Mutchler).

Selenophorus beauvoisi Dejean—det. P. J. Darlington
AMC: at Ensenada iii-36.

Selenophorus chalybeus Dejean
at light at Guanica (691-13 det. A. J. Mutchler).

Selenophorus ramosi Darlington 39-97: TYPE from Guanica Lagoon, others from Ensenada, P. R.
at light at Guanica (1095-13 det. P. J. Darlington).

Selenophorus sinuatus Gyllenhal
at Caguas (SSC det. A. J. Mutchler); at Cayey, reported attacking tobacco leaves (343-23 det. P. J. Darlington).

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Colpodes estriatus Darlington 39-96: TYPE from El Yunque, P. R.
Ramos Col.: paratype from El Yunque v-38, elev. 3,000 ft.

DYTISCIDAE

Rhantus calidus F.—det. A. J. Mutchler
Garcia-Diaz 38-94: listed.

Laccophilus proximus Say
Garcia-Diaz 38-94: listed, det. A. J. Mutchler.

Pachydrus globosus Aubé
Garcia-Diaz 38-94: listed.

Pachydrus brevis Sharp
Garcia-Diaz 38-94: listed.

Hydrocanthus iricolor Say
Garcia-Diaz 38-94: listed.

Copelatus angustatus Chevrolat
Garcia-Diaz 38-94: listed.

Eretes sticticus L.—det. L. L. Buchanan
in salt lagoon at Ensenada (36-36).

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Thermonectes basillaris Harris—det. A. J. Mutchler
Garcia-Diaz 38-94: listed.

Thermonectes circumscriptus Latreille
Garcia-Diaz 38-94: listed.

Thermonectes margineguttatus Aubé
Garcia-Diaz 38-94: listed.

Megadytes giganteus Castelnau
Wolcott 37-79: larvae of predaceous on tadpoles of *Bufo marinus L.*
in pool at Pt. Las Marias (41-36).

GYRINIDAE

Dineutus metallicus Aubé
Garcia-Diaz 38-94: listed.

Dineutes americanus L.—det. L. L. Buchanan
from reservoir at Malezas farm, Aguadilla (263-39).

Dineutus longimanus Olivier, var. **portoricensis** Ochs
Garcia-Diaz 38-94: listed.

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Gyrinus rugifer Regimbart
Garcia-Diaz 38-94: listed.

HYDROPHILIDAE

Derallus rudis Sharp—det. A. J. Mutchler
Garcia-Diaz 38-94: listed.

Enochrus nebulosus Say—det. A. J. Mutchler
Garcia-Diaz 38-94: listed.

Enochrus ochraeus Melsheimer—det. A. J. Mutchler
Garcia-Diaz 38-94: listed.

Berosus tesselatus Fleutiaux
Garcia-Diaz 38-94: listed.

Berosus guadeloupensis Fleutiaux & Sallé—det. A. J. Mutchler
Garcia-Diaz 38-94: listed.

Stethoxus insularis Castelnau
(as *Hydrophilus*) Garcia-Diaz 38-94: listed.

Stethoxus intermedius J. Duval
(as *Hydrophilus ater intermedius* J. Duval) Garcia-Diaz 38-95: listed.
at light (I No. 7331 det. L. L. Buchanan as *S. ater*), (336-39).

Nechydrophilus phallicus Orohymont—det. A. J. Mutcher
Garcia-Diaz 38-95: listed.
(291-22 det. A. J. Mutchler).

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Tropisternus collaris F.
Garcia-Diaz 38-95: listed.

Tropisternus lateralis F.
Garcia-Diaz 38-95: listed.

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Paracymnus subcupreus ? Say—det. A. J. Mutchler
Garcia-Diaz 38-95: listed.

Ochthebus sp.—det. A. J. Mutchler
Garcia-Diaz 38-95: listed.

Pelosoma sp.—det. A. J. Mutchler
Garcia-Diaz 38-95: listed.

Phaenotypus palmarum Schwarz—det. A. J. Mutchler
Garcia-Diaz 38-95: listed.

Dactylosternum abdominale F.
the specimen recorded as *D. flavicorne* Mulsant "common under bark of decaying bucare tree, *Erythrina glauca,* at Cayey (30-217)" has been re-determined by A. J. Mutchler as this species; also, in cacao pods at Mayaguez (I No. 6385); in decaying fig at Mayaguez (I No. 6258).

Cercyon sp.
in cacao pods at Mayaguez (I No. 6375).

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STAPHYLINIDAE

Leiodes sp.—det. W. S. Fisher
in decaying wood at Mayaguez (I No. 6373).

Holotrochus cylindricus Erichson
in rotton wood at Añasco (I No. 6238), at Mayaguez (I No. 6361 det. as "sp.").

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Philonthus alumnus Erichson
in icaco pods at Mayaguez (I No. 6370 det. as "sp."); in guavas at Mayaguez (I No. 6381), at light at Palo Seco (I No. 6564).

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Coproporus pulchellus Erichson—det. E. A. Chapin
in guavas at Mayaguez (I No. 6383).

Gyrophaena sp.
common on a fungus, at Mayaguez (I No. 6371); in cacao pods at Mayaguez (I No. 6378).

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PTILIIDAE

Acrotrichis atomaria DeGeer
Leng & Mutchler.
three species in cacao pods at Mayaguez (I No. 6377, 6385).

SCAPHIDIIDAE

Scaphisoma sp.—det. H. S. Barber
in decaying wood at Añasco (I No. 6234).

HISTERIDAE

Plaesius javanus Erichson
Anon 38-101: a predator on *Cosmopolites sordidus* Germar introduced from Java.
Anon 39-109: not recovered.

Lioderma 4-dentatum F.
under bark of decaying bucare tree at Mayaguez (I No. 7269).

Hister sp. "near *coenescens* Erichson"—det. H. S. Barber
at Coamo (I No. 5932); in dung at Añasco (I No. 6264).

Omalodes ruficlavis Sharp
in flight at Salinas (298-39).

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LYCIDAE

The record of *Thonalmus dominicensis* Chevrolat is unquestionably in error, the specimens (re-determined LFM & GNW) being the following:

Thonalmus chevrolati Bourgeois
Wolcott & Martorell 37-578: did not eat egg-clusters of *Diatraea saccharalis* F. in captivity.
Wolcott & Martorell 37-535 to 536: definitely established in Puerto Rico.
adults in cane field at Guanica (17-36 det. GNW), at Yauco (5-37), at Guayanilla (27-37, 279-39, 323-39), at Aguadilla (137-40).

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CORYNETIDAE

Necrobia rufipes DeGeer
AMC: on dried meat at Mayaguez, December 1939, det. E. A. Chapin (H. Ayguabibas).

LYMEXYLIDAE

Atractocerus brasiliensis Laporte & Serville (not in PTINIDAE, IB-239)
at light at Lares, collected by Felipe Mora (76-38 det. H. S. Barber).

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OEDEMERIDAE

Oxacis litoris Wolcott
resting on leaves of sea-grape at Dorado (I No. 6531 det. H. S. Barber), on Mona Id. (383-39), also resting on leaves of Honduras mahogany and castor bean, and at light, Mona Id. (201-40).

Ananca vittata F.
resting on leaves of sea-grape, and at night (August) common at light, Mona Id. (91-39, 202-40).

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MORDELLIDAE

Ray, Eugene, "Synopsis of the Puerto Rican Beetles of the Genus Mordellistena, with Descriptions of New Species." Proc. U. S. Nat. Mus., **84**(3020): 389-399, fig. 1, ref. 5. Washington, 1937.

Mordellistena annuliventris Quedenfeldt
Ray 37-390: "ventral surface bicolorous," at Aibonito (Oakley).

Mordellistena angustiformis Ray 37-390: TYPE from Yauco, P. R., others from Adjuntas.

Mordellistena barberi Ray 37-395: TYPE from Ponce, P. R. (Oakley) on moca, female on coffee at Juana Diaz.

Mordellistena danforthi Ray 37-392: TYPE from Villalba, P. R.

Mordellistena ephippum Ray 37-398: TYPE from Aibonito, P. R., other from Ponce on *Eugenia* (Oakley).

Mordellistena ferruginea F.
Ray 37-390: "entire body surface flavous," eleven specimens.

Mordellistena humeralis Ray 37-393: TYPE from Villalba, P. R.

Mordellistena leai Ray 37-396: TYPE from Bayamon, P. R. (Lesne), other from Maricao.

Mordellistena lineata Ray 37-395: TYPE from Guanica, P. R.

Mordellistena lucidovriga Ray 37-398: TYPE from Maricao, P. R. (Morrison).

Mordellistena marginicollis Mäklin, F. W., "Neue Mordelliden." Acta Soc. Sci. Fennicae, **10**( ): 561-595, 1875.

Mordellistena signaticollis Quedenfeldt
Ray 37-390: "hind basitarsus with 2 oblique ridges."

Mordellistena varietas Ray 37-391: TYPE from Adjuntas, P. R., others from Villalba and Maricao.

Mordellistena y-nigrum Ray 37-397: TYPE from Juana Diaz, P. R., on *Inga laurina* (Oakley).

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RHIPIPHORIDAE

Macrosiagon discicolle melanoptera Chevrolat
on leaves of sugar-cane at Isabela (2-38); on flowers of *Borreria verticillata* at Aguadilla (53-39), at Yabucoa (313-39), at Vega Baja and Rio Blanco (66-40).

Macrosiagon flavipennis Lea—det. G. E. Bryant (Brasilian specimens)
on flowers of *Hyptis atrorubens* (369-39) on flowers of *Borreria verticillata* at Vega Baja (64-40), at Luquillo (178-40).

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MELOIDAE

Tetraonyx quadrimaculatus F.
on flowers of lavender pea at Guajataca (272-39).

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ELATERIDAE

Chalcolepidius silbermanni Chevrolat (not *Chalcolepidus*)
at Aguadilla (40-38); reared from dead trunk of *Albizzia lebbeck* infested with Cerambycid larvae, at Ponce (65-39).

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Pyrophorus luminosus Illiger

Jepson 36-6, 14 to 17: predacious on white grubs, collections and observations in Puerto Rico, and results of shipments to Mauritius.

Jepson, W. T., "A Summary of the Results of the Phytalus Investigation, 1933-36." pp. 19. Port-Louis, Mauritius, 1936: survival of the journey to Mauritius from Puerto Rico; more should be imported.

Anon 38-102: shipments to Mauritius.

Wolcott 37-44: negligible mortality in shipments totaling 3,500 larvae to Barbados.

Wolcott 37-81: in toad excrement.

at light at Rio Piedras and on sugar-cane at Aguadilla (163-40), the first noted in several years, since *Bufo marinus* became abundant.

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Conoderus bifoveatus P. B. (not *Monocrepidus*)
on sugar-cane at Quebradillas (223-39), at Aguadilla (262-39); at Mayaguez (I No. 7296).

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Aeolus elegans F.
hiding in gall-deformed leaves of ucar, Vieques Id. (99-40).

Dicrepidius ramicornis P. B. ?—det. W. S. Fisher
under castor bean leaf, Mona Id. (88-39).

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BUPRESTIDAE

Acmaeodera gundlachi Fisher
resting on weeds, Mona Id. (94-39 det. W. S. Fisher).

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Polycesta porcata F.—det. W. S. Fisher
resting on cane leaf at Juana Diaz (17-37); reared from larva in furniture made of mahogany imported from Santo Domingo (182-40).

Polycesta thomae Chevrolat
on Mona Id. (20-37 det. W. S. Fisher).

Chrysobothris megacephala Castelnau & Gory
reared from aceitillo, *Zanthoxylum flavum*, at Guanica Insular Forest (62-38).

Chrysobothris tranquebarica Gmelin
on dead *Inga vera* tree at Ciales (35-36); on dead *Bucida buceras* tree at Guayanilla (43-37); on stump at Mayaguez (I No. 7271).

Chrysobothris wolcotti Fisher
all immature stages in crape myrtle (69-37); in cane field at Ponce (68-37 det. W. S. Fisher).

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Micrasta oakleyi Fisher
on castor bean leaf, Mona Id. (177-39 det. W. S. Fisher as "sp. nov., close to *oakleyi* Fisher").

ELMIDAE

Cylloepus danforthi Musgrave
Garcia-Diaz 38-94: listed.

Neoelmis gracilis Musgrave
Garcia-Diaz 38-94: listed.

Phanocerus hubbardi Schaeffer—det. P. N. Musgrave
Garcia-Diaz 38-94: listed.

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HELODIDAE

Ptilodactyla sp. "perhaps *emarginata* Chevrolat"
on decaying wood at Mayaguez (I No. 6382).

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DERMESTIDAE

Globicornis fulvipes Guerin
in dead butterflies (I No. 6865).

Dermestes caninus Germar—det. H. S. Barber
larvae and adults in shell of dead sea turtle, Mona Id. (262-40), and on goat hides.

OSTOMIDAE

Tenebroides mauritanicus L.
at light, Mona Id. (122-39).

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NITIDULIDAE

Conotelus fuscipennis Erichson
in flowers of gardenia at Caguas (I No. 6496 det. as "sp.").

Carpophilus dimidiatus var. **mutilatus** Erichson
in stored mahogany seed at Cayey (22-37 det. E. A. Chapin).

Carpophilus hemipterus L.
Wolcott 40-30: in maga pods.

Haptoncus luteolus Erichson
in fruits of *Triphasia trifolia* at Palo Seco (I No. 6501); at light, Mona Id. (379-39 det. E. A. Chapin).

page 220
Lobiopa insularis Castelnau
in rotten guava fruits (I No. 7050); under bark of tree at Bayamon (I No. 6426).

MONOTOMIDAE

Europs apicalis Reitter
Wolcott 40-30: in maga pods.

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CUCUJIDAE

Silvanoprus scuticollis Walker—det. Ferd. Nevermann
at Mayaguez ix-28 (S. T. Danforth).

Ahasverus (Cathartus) advena Waltl
(I No. 6578); under bark of dead tree, Mona Id. (180-39 det. W. S. Fisher as "sp.").

page 223
Telephanus pallidulus Chevrolat
on grapefruit leaf at Bayamon (I No. 6002).

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COLYDIIDAE (not COLYDIDAE)

Synchita grannulata Say (not *granulata*)
under bark of fence post on El Yunque (355-39).

Bitoma undata Guerin
in decaying wood at Añasco (I No. 6240).

page 225
Philothermus puberulus Schaufuss—det. W. S. Fisher.
on El Yunque (I No. 6566); on decaying wood at Añasco (I No. 6239).

LATHRIDIIDAE (not LATHIDIIDAE)

Eufalia unicostata Belon—det. W. S. Fisher
[Hoffman, W. A., "*Eufallia unicostata, a Fungus Eating Beetle* New to Puerto Rico." Jour. Ec. Ent. **33**(5): 810-11. Menasha, Wis., October 1940.]
larvae (det. W. H. Anderson) reared on fungus growing on, and adults abundant on casein-wash walls, School of Tropical Medicine (W. A. Hoffman).

PHALACRIDAE

Phalacrus acutangulus Chevrolat—det. A. J. Mutchler
in old cotton bolls at Pt. Cangrejos (552-22); at light (340-39).

Euxestus erithacus Chevrolat
at light (I No. 6527).

Acylomus sp.—det. W. S. Fisher
at light, Mona Id. (379-39).

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COCCINELLIDAE

Bartlett, K. A., "A search in the Guianas and Trinidad for Predatory Beetles of the Bamboo Scales." Jour. Agr. Univ. P. R., **22**(4): 493-5. San Juan, March 23, 1939.

Coelophora inaequalis F.—Introduced
Anon 39-98: predaceous on aphids in Hawaii, released at Mayaguez, Cabo Rojo and Villalba.

Hyperaspis apicalis Mulsant
(as "sp.") Anon 39-98: predaceous on *Sipha flava* at Arroyo. Martorell 40-24: attacking *Pseudoccus nipae*.

Hyperaspis belloti—Introduced
146 adults collected by K. A. Bartlett in Trinidad, B. W. I., released at Rio Piedras, P. R. (8-39).

Hyperaspis connectens Thunberg
Fife 39-10: predaceous on *Aphis gossypii*.

Hyperaspis trilineata Mulsant—Introduced
Wolcott 37-44: introduction from Barbados, releases at Isabela, Fajardo, Arroyo, Aguirre and Guanica.

Pentilia insidiosa Mulsant (= *castanea* Mulsant)—Introduced
Bartlett 39-494 and Anon 39-105: from Trinidad and British Guiana, reared in laboratory and released.

Delphastus sp.—Introduced
Bartlett 39-494 and Anon 39-103: from Trinidad, predaceous on bamboo scales.
(as "related to *Delphastus* sp.") abundant on papaya infested with scale at Isabela (44-39 det. E. A. Chapin).

Curinus sp.—Introduced
Bartlett 39-494 and Anon 39-103: from Trinidad, predaceous on bamboo scales.
Anon 39-106: from Martinique, F. W. I.

Platynotus lividigaster Mulsant—Introduced
Anon 39-99: from Australia via Hawaii, released at Lajas.

Scymnus aeneipennis Sicard—Introduced
Dohanian 37-244: from Trinidad.

page 228
Scymnus roseicollis Mulsant
Fife 39-10: predaceous on *Aphis gossypii.*
on castor bean plants, Mona Id. (174-39 det. E. A. Chapin); on maga leaves at Lares (422-40); on *Tabebuia pallida* at Cayey (353-40).

Decadiomus pictus Chapin
feeding on scales on coconut (I No. 6112 det. as "sp." E. A. Chapin).

page 229
Cryptolaemus montrouzieri Mulsant—Introduced
Wolcott 39-508: successful establishment in P. R.
Fife 39-10: predaceous on cotton mealybugs.
on guava bushes at Sabana Grande (97-37); on *Rauwolfia tetraphylla* infested with *Coccus viridis* at Aguadilla (6-38); feeding on cottony cushion scale at Isabela (54-39).

Rodolia (Vedalia) cardinalis Mulsant—Introduced
Wolcott 37-54, Wolcott 38-82, Wolcott 39-33; a supply maintained in the Insectary at the Experiment Station for release where outbreaks of the cottony cushion scale occur.
Wolcott 39-508: successfully established in P. R.
on Mona Id. (126-39, 40-40, 254-40); natural spread to Mayaguez from Guajataca (132-40).

Psorolyma maxillosa Sicard
at Mayaguez (I No. 6097), at Lares (423-40).

page 230
Scymnillus nunenmacheri Sicard
Martorell 40-24: feeding on *Pseudococcus nipae.*

Scymnillodes cyanescens violaceus Sicard (not *volaceus*)
Bartlett 39-493: feeding on bamboo scale.

page 231
Psyllobora nana Mulsant.
Fife 39-10: predaceous on *Aphis gossypii.*

page 232
Cycloneda sanguinea L.
Wolcott & Martorell 37-578: did not eat egg-clusters of *Diatraea saccharalis* F. in captivity.
Wadley 37-107: a predator on *Sipha flava.*
Anon 39-89: a predator on *Sipha flava.*
Fife 39-10: a predator on *Aphis gossypii.*
on weeds, Mona Id. (92-39).

Daulis ferruginea Olivier
abundant on leaves and flowers of *Inga laurina,* Peñon del Collao, Cayey (125-40).

Cryptognatha nodiceps Marshall—Introduced
Dohanian 37-244: attacking bamboo scales in Trinidad.
Anon 38-97: "well established" in P. R.
Bartlett 39-494: introduced from Trinidad.
Anon 39-104: feeds on coconut scales in P. R., not on bamboo scales.

Cryptognatha simillina Sicard—Introduced
Dohanian 37-244: attacking bamboo scales in Trinidad.
Anon 38-97: "well established" in P. R.
Bartlett 39-494: introduced from Trinidad.
Anon 39-104: feeds on coconut scales in P. R., not on bamboo scales.

Azya trinitatis Marshall—Introduced
Dohanian 37-244: attacking bamboo scales in Trinidad.
Anon 38-97: "well established" in P. R.
Bartlett 39-494: introduced from Trinidad.
Anon 39-104: feeds on coconut scales in P. R., not on bamboo scales.

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Egius platycephalus Mulsant—Introduced
Anon 39-102: from Cuba, predaceous on bamboo scales.

Chilocorus cacti L.—Introduced
Anon 39-100 to 102: introduced from Texas and Cuba, reared on papaya scales in P. R., released on scale-infested bamboo. Illustration.
feeding on papaya scales at Arecibo and Isabela (95-40).

ALLECULIDAE

Hymenorus sp. "probably new" det. E. A. Chapin
at light and on weeds, Mona Id. (123-39, 203-40).

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TENEBRIONIDAE

Opatrinus pullus Sahlberg (not *Hopatrinus*)
on Mona Id. (12-37 det. as "sp." E. A. Chapin, 192-39).

Blapstinus punctatus F.
on Mona Id. (195-39 det. as "sp." E. A. Chapin).

Phaleria variabilis Quedenfeldt
under seaweed on the beach at Pt. Cangrejos (390-22 det. A. J. Mutchler), at Santurce (I No. 7318), at Cataño (I No. 5966, 5967); at light, Mona Id. (195-39 det. as "prob." E. A. Chapin).

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Eutomus cornutus Arrow—det. E. A. Chapin
on fungus at Mayaguez (I No. 6376).

"genus near **Pentaphyllus**"—det. E. A. Chapin
in polypore fungus on El Yunque (I No. 6519).

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Dioedus sp.
at Mayaguez (I No. 6365).

Doliema pallida Say
on Mona Id. (221-39 det. E. A. Chapin, 39-40), under bark of *Elaphrium simaruba* at Guanica (332-40).

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ANOBIIDAE

Lasioderma serricorne F.
Gage 39-22: attacking tobacco in storage.
in cigar (I No. 6733); in imitation leather hat-box (28-39).

page 240

Catorama herbarium Chevrolat
in binding of books (I No. 7092, 7093).

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BOSTRYCHIDAE

Dinoderus minutus F.
Anon 36-18: "not a termite, as the Spanish term 'polilla' might be taken to indicate."
Anon 37-30 to 38: experiments in control on bamboo conducted by Donald F. Gibbons and Harold K. Plank. Hot creosote effective.
Anon 39-29 to 36: summarizing the studies of H. K Plank in control as a pest on bamboo.
Anon 39-109 to 118: experiments in control by absorption of chemicals showed lowest infestation in bamboo cured in the clump (check).
Plank, H. K., "*Peregrinator biannulipes* Montr., a Predator on the Bamboo Powder-Post Beetle in Puerto Rico." Jour. Ec. Ent., **32**(1): 151. Menasha, Wisconsin, February 1939.

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Apate francisca F.
Martorell & Wolcott 39-44: effective control of an extensive outbreak in young mahogany trees near Guayanilla.
Martorell 39-251: host trees and control.
larvae, pupae and adults in mahogany log at Mayaguez (38-37); female beetles attacking Dominican mahogany, flamboyánt, ucar and casuarina seedlings, 3 to 4 years old, at Guayanilla (39-37); attacking cultivated grape vine at Ponce (63-38); attacking mangle poles used for drying tobacco, Tobacco Institute.

Zylomeira torquata F.
at light, Mona Id. (162-39, 375-39 det. W. S. Fisher).

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CISIDAE

Ceracis sp.—det. W. S. Fisher
on polypore fungus (I No. 6141, 6142).

Lyctus caribeanus Lesne—det. W. S. Fisher
Anon 39-118: in stored bamboo at Mayaguez.
in mahogany sapwood made up into furniture (31-39 det. W. S. Fisher).

Cis sp.
on fungus at Mayaguez (I No. 6364); in decaying wood at Añasco (I No. 6230).

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SCARABAEIDAE

Chapin, E. A., "A Revision of the West Indian Beetles of the Scarabaeid Subfamily Aphodiinae." Proc. U. S. Nat. Mus., **89**(3092): 1-41. Washington, D. C., May 23, 1940.

Canthon pilularius L. Introduced
Bartlett 39-2 and Anon 39-107: introduced from Texas, reared in P. R., released at Arroyo, Salinas, Fajardo, Penuelas and Ponce.

Phaenus triangularis Say—Introduced
Bartlett 39-2: introduced from Texas.

Copris incertus var. **prociduus** Say—Introduced
Bartlett 39-2: introduced from Hawaii.

Canthochilum histeroides Harold
in the mountains north of Yauco (I No. 6231).

Aphodius cuniculus Chevrolat
Chapin 40-7: many specimens from P. R., Vieques Id.

Aphodius lividus Olivier
Chapin 40-6: from P. R. and Vieques Id.

Psammodius bidens Horn
Chapin 40-10: "one specimen taken on the beach at Humacao, P. R., October 8, 1935, Blackwelder station 56."

Saprosites blackwelderi Chapin 40-11: TYPES from Mayaguez, P. R. (R. E. Blackwelder), another from Añasco (R. G. Oakley), both from rotting wood.

Ataenius darlingtoni Hinton, H. E., *in* Ann. Mag. Nat. Hist., ser. 10, **20**( ): 179, fig. 6-9: TYPE from Cartagena Lagoon, P. R.
Chapin 40-30: from P. R.

Ataenius edwardsi Chapin 40-26: TYPE from Jamaica, others from P. R.

Ataenius frater Arrow
Chapin 40-32: from P. R.

Ataenius gracilis Melsheimer
Chapin 40-25: from P. R. and Vieques Id.

Ataenius haroldi Steinheil
Chapin 40-15: seven specimens from P. R.

Ataenius luteomargo Chapin 40-36: TYPE from Dominica, B. W. I., others from P. R.

Ataenius strigicauda Bates
Chapin 40-31: from P. R.

Ataenius tenebrosus Arrow
Chapin 40-23: from P. R. and Vieques Id.

Ataenius versicolor Schmidt
Chapin 40-36: one specimen from Pt. Cangrejos, P. R., April 6, 1920 (G. N. Wolcott).

Ataenius vincentiae Arrow
Chapin 40-19: at Coamo, P. R. (S. T. Danforth).

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All the records under *Ataenius marginatus* F.—det. E. A. Schwarz should be transferred, according to re-determinations by E. A. Chapin and A. J. Mutchler, to *Ataenius terminalis* Chevrolat.

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Phyllophaga adjuntas Saylor, L. W., "Ten new West Indian scarab beetles of the genus *Phyllophaga,* with two new names." Jour. Washington Academy Science, **30**(7): 305-314, fig. 10. Washington, D. C., July 15, 1940; p. 312; TYPE from Isolina, P. R., others from Adjuntas.

one male at light Camp Doña Juana, Villalba (413-40 det. E. A. Chapin from drawing of genitalia).

page 249

Phyllophaga vandinei Smyth
Jepson 39-3 to 30: distribution (p. 3): 3d instar grubs parasitized by *Elis zanthonotus,* 2nd instar by *Elis haemorrhoidalis,* 3d instar by *Campsomeris dorsata, C. trifasciata* and *C. tricincta.*

grubs attacking plantain roots at Mayaguez (I No. 6061); adults defoliating moca, *Andira inermis,* and eating leaves of sugar-cane down to the midrib, at San Sebastian (165-40, 424-40).

Phyllophaga portoricensis Smyth
Jepson 39-3 to 30: distribution, and parasitism by Scoliid wasps.
Wolcott 37-82: 195 adults in 58 pellets of excrement of the giant Surinam toad, *Bufo marinus* L., at Rio Piedras, April, 1936.
Wolcott 39-508: control by *Bufo marinus* in P. R.
adults feeding on leaves of sea-grape in mid-April, no rain (35-38); at light, El Yunque (50-36).

page 250
Phyllophaga citri Smyth
Jepson 39-3 (distribution) to 29: parasitism of 2nd instar grubs by *Elis haemorrhoidalis,* of 3d instar by *Elis zanthonotus,* and rarely by *Campsomeris trifasciata.*
adults feeding on citrus leaves at Maricao (I No. 6810).

Phyllophaga crinitissima More
Jepson 39-3: "rare."
one female at light, El Yunque (51-36 det. GNW).

page 251
Phyllophaga guanicana Smyth
Jepson 39-3: distribution.

Phyllophaga monana Moser, J., *in* Stettiner Ent. Zeit., **82**( ): 181. Stettin, 1921: TYPE from Mona Id.
at light, Mona Id. (10-37, 187-39, 218-40 det. E. A. Chapin).

Phyllophaga yunqueana Chapin
one male at light, El Yunque, (37-39 confirmed E. A. Chapin).

Phyllophaga wolcotti Saylor 40-307: TYPE from El Yunque, P. R., others from mountains north of Yauco iv-20-36 (R. G. Oakley).
two males and two females at light, El Yunque (36-39 TYPE), April 6, 1939.

Phytalus apicalis Blanchard
Jepson 39-3 (distribution) and 27: 3d instar grubs parasitized by *Elis haemorrhoidalis.*
at light, Bayamon (I No. 6043); adults in spider web, Faro de Cabo Rojo (59-37 det. E. A. Chapin).

page 252
Parachalepus barbatus F.
Wolcott 37-81: abundance of adults in excrement of *Bufo marinus* L. at Rio Piedras.
at light (227-39).

page 253
Dyscinetus picipes Burmeister
Wolcott 37-83: scarcity of, in excrement of *Bufo marinus* L.
adults attacking yautia corms and roots at Cayey (59-38).

Ligyrus tumulosus Burmeister
Jepson 39-28: 3d instar grubs parasitized by *Campsomeris dorsata*.
Wolcott 37-80: scarcity due to *Bufo marinus* L.
on Mona Id. (83-39, 220-40).

page 254
Strataegus quadrifoveatus P. B.
(as *S. oblongulus* (Beauv.)) Anon 38-92: observations on continued by H. K. Plank.
burrowing into pineapple fruit at Palo Seco (I No. 7287).

page 256
Strataegus barbigerus Chapin
at El Verde Camp, Rio Grande, elev. 1,200 ft. (3-39); male and female from base of tree, *Metopium toxiferum*, on Mona Id. (82-39).

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LUCANIDAE

Paxillus (Passalus) crenatus MacLeay
in rotten wood, Lares-Yauco road (308-21 det. A. J. Mutchler); at Mayaguez (617) R. H. Van Zwaluwenburg, det. E. A. Chapin.

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CERAMBYCIDAE

Xystrocera globosa Olivier—det. W. S. Fisher
(I No. 6808).

Stenodontes bituberculatus P. B.
in old tree stump, Mona Id. (84-39).

Derancistrus (Solenoptera) thomae L.
(I No. 6526); adult on dead wood at Guayanilla (40-37); adult in flight at Quebradillas (284-39).

p. 259
Smodicum impressicole Lac.—det. W. S. Fisher
Ramos Col.: at Mayaguez v-36.

Methia necydalea F.
at light, Mona Id. (132-39 det. W. S. Fisher, 258-40).

Chlorida festiva L.
larvae in casuarina fence posts at Naguabo (1-39); adults at light at Villalba (410-40).

Eburia quadrimaculata L.
at light at Guajataca (32-38), on Mona Id. (87-39).

page 260
Elaphidion insulare Newman
on Mona Id. (13-37 det. W. S. Fisher).

Elaphidion irroratum L.
reared from dead *Albizzia lebbeck* at Ponce (63-39); adult from Mona Id. (85-39).

Elaphidion mutatum Gahan—det. W. S. Fisher
larvae in live tree of aceitillo, *Zanthoxylum flavum,* Guanica Insular Forest (13-38, 62-38).

Elaphidion spinicorne Drury
at light, Mona Id. (86-39, 257-40; reared from *Albizzia lebbeck* at Ponce (64-39).

Elaphidion tomentosum Chevrolat
larvae in wood of crape myrtle (78-37).

page 261
Heterachthes ebenus Neuman—det. W. S. Fisher
Ramos Col.: at Mayaguez iv-37.

Heterachthes 4-maculatus F. (not *Heterachthe*)
(56-39).

Merostenus attenuatus Chevrolat
at light, Mona Id. (278-40 det. W. S. Fisher).

Xystrocera globosa Olivier—det. W. S. Fisher
Ramos Col.: at Arroyo xii-37.

page 262
Cylindera flava F.
at light, Mona Id. (145-39 det. W. S. Fisher), at Ponce (146-40); all stages infesting logs of *Bucida buceras* at Guayanilla (41-37).

Acyphoderes arulenta Kirby
resting on sugar-cane at Toa Baja and Coloso (37-38); from stump at Mayaguez (I No. 7267).

Euryscelis suturalis Olivier
at Bayamon (I No. 6042).

Neoclytus araeniformis Olivier
in dead wood at Mayaguez (I No. 7243); all stages in logs of *Bucida buceras* at Guayanilla (42-37).

page 263
Leptostylus argentatus J. Duval
reared from aceitillo, *Zanthoxylum flavum,* Guanica Insular Forest (68-38 det. W. S. Fisher).

page 264
Leptostylus sp. nov.—det. W. S. Fisher
Ramos Col.: at Mayaguez vii-32.

Oreodera glauca L.—det. W. S. Fisher
Ramos Col.: at Mayaguez ii-35, xii-36, at Adjuntas ii-35.

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Ataxia alboscutellata Fisher

Fife 39-10: larvae boring in cotton stalks at Sabana Grande.

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CHRYSOMELIDAE

Lamprosoma longifrons Suffrian (not *Lamprosema*)

Nodonota wolcotti Bryant

on weeds, Mona Id. (290-40 det. as "prob." H. S. Barber).

Metachroma antennalis Weise

at light at Guajataca (52-39).

page 270

Leucocera laevicollis Weise

on *Malpighia punicifolia* at Mayaguez (I No. 7343).

Myochrous armatus Baly

resting on sugar-cane at Salinas (371-39).

Myochrous sp. (not the above)—det. H. S. Barber

Fife 39-9: on cotton

on weeds at Ponce (I No. 5930).

page 271

Diabrotica graminea Baly

Fife 39-10: adults feed on cotton leaves.

page 273

Luperodes antillarum Blake, Doris H., "Ten New Species of West Indian Chrysomelidae (Coleoptera)." Proc. Ent. Soc.

Washington, **34**(4): 67-78, pl. 1. Washington, D. C., April 1937: TYPE from Rio Piedras, P. R. (R. T. Cotton) on *Jussiaea suffruticosa,* May 8, 1917.

(400-17 TYPE), also includes from IB-273:

"**Luperus** sp. det. H. S. Barber

on Caperonia and Jussiaea at Loiza (No. 4198).

"**Luperodes** sp.

Danforth: at Yabucoa vi-30, Cartagena Lagoon iii-27."

Ectmesopus vitticollis Blake, Doris H., "A New Genus of Galerucinae (Coleoptera) from the West Indies." Proc. Ent. Soc. Washington, **42**(5): 95-104, pl. 1. Washington, D. C., May 28, 1940: TYPE from Ponce P. R. (R. G. Oakley) on *Peiransia,* illustration.

Ectmesopus zonatus Blake 40-100: TYPE from Maricao Insular Forest, P. R. (P. J. Darlington).

page 275

Homophoeta albicollis F.

on Santiago Id., November 1939 (W. A. Hoffman); resting on sugar-cane at Isabela (8-38), at Guanica (329-39).

page 278

Hermaeophaga cubana Bryant—det. G. E. Bryant

millions of adults clustered on leaves of tree, top of hill near Guayama (50-22).

Hermaeophaga cylindrica Weise

on weeds at Mayaguez (I No. 7394); on "mata bellaca" at Guanica (359-39); on ?, Mona Id. (47-40).

page 279

Epitrix cucumeris Harris

Gage 39-22: as a pest on tobacco leaves.

on potatoes at Cidra (I No. 6212).

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Epitrix parvula F.

Gage 39-22: as a pest on tobacco, riddling the leaves.

on Irish potatoes at Cidra (I No. 6215).

page 281

Chaetocnema apricaria Suffrian

on ? at Coamo (I No. 5927); on Santiago Id., November 1939 (W. A. Hoffman).

Systena basalis J. Duval

Gage 39-22: a pest on tobacco leaves.

Fife 39-10: adults feed on cotton leaves.

on Irish potatoes at Cidra (I No. 6215).

page 283

Longitarsus varicornis Suffrian

adults abundant on *Psidium guajava* at Aguada (26-37 det. H. S. Barber).

Phyllotreta guatemalensis Jacoby

on *Cleome pentaphylla* at Mayaguez (I No. 7267).

page 284

Aphthoma compressa Suffrian

on *Stigmaphyllon ligulatum* at Camuy (20-24 det. A. J. Mutchler): resting on sugar-cane at Aguadilla (44-38); on *Clusia rosea* and "coral," Mona Id. (256-40).

Mesomphalia exclamationis L. (= *Hilarocassis*)

Fife 39-10: adults feed on cotton leaves.

on *Ricinus communis* at Ponce (I No. 4498, 6584, 13-36); on ? at Mayaguez (H. L. Dozier), October 1935 and (L. C. Fife), December 1935; resting on sugar-cane at Guanica (28-37), at Aguadilla (151-39), at Manati (113-39).

page 285

Chelymorpha polysticha Boheman

resting on sugar-cane at Loiza (58-38).

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BRENTIDAE

Belophorus maculatus Olivier
on sierra palm, El Yunque (52-36).

page 288
Brentus volvulus F.
under bark of decaying *Erythrina* tree at Mayaguez (I No. 7253); under bark at Mayaguez (I No. 6380 det. as "sp.").

page 289

CURCULIONIDAE

Attelabus coccolobae Wolcott
on sea-grape at Patillas (81-37); on *Coccolobis laurifolia* at Guanica (334-40); on *C. grandifolia* at Maricao (389-40).

page 290
Attelabus sexmaculatus Chevrolat
on *Psidium guajava* at San Sebastian (7-38); on *Eucalyptus cytriodora* seedlings in nursery at Cayey (113-40), at Patillas (431-40).

Cylas formicarius F.
Wolcott 37-58: drought and cracking of soil largely determines extent of infestation, not seed selection.

page 292
Apion martinezi Marshall
Martorell & Wolcott 39-44: injury to aceitillo seed.
very abundant in aceitillo seed from Camp Buena Vista, Maricao (14-38).

Tachygonus sp. near *gowdeyi* Marshall—det. L. L. Buchanan
on guácima at Boquerón (I No. 6233).

Artipus monae new species
Elongate oblong. Piceous, everywhere densely clothed with dull silvery scales, often tarnished to a faded brown in larger individuals. Head with scattered, coarse punctures; the median groove from deeply notched beak extending only as far back as between the eyes (not appearing to almost cut the head in two, as often in *A. psittacinus* Gyllenhal from Haiti). Thorax sub-cylindrical, as wide as long, coarsely punctate, interspersed with coarse, appressed whitish hairs; the median groove often distinct near base. Elytra twice as long as wide, broadest half-way to apex, sides not parallel; *elytral declivity abrupt,* often nearly vertical from a lighter-colored raised oval area on disc; striae with deep coarse punctures; intervals convex with a single irregular zig-zaging row of coarse appressed short whitish hairs.
Length 5. to 6.5 mm.

Described by G. N. Wolcott from 15 specimens collected by L. F. Martorell on Mona Island, August 8, 1939 (P. R. Acc. No. 130-39) most abundant on casuarina foliage, less abundant beneath eggplant leaves.

Prepodes 15-punctatus Olivier

a 21-spotted irridescent green weevil, feeding on corcho on corcho prieto, *Torrubia fragrans,* Yabucoa (495-40).

Prepodes roseipes Chevrolat

(as *Exophthalmodes*) Fife 39-10: adults eat cotton leaves.

at Mayaguez (I No. 6843, 6993); in fruit fly trap at Palo Seco (I No. 6990); resting on sugar-cane at Isabela (254-39); feeding on tender leaves of algarrobo, *Hymenaea courbaril,* at Vega Baja (171-40).

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Compsus maricao Wolcott

adult feeding on leaf of *Cecropia peltata* at Villalba (171-40).

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Diaprepes abbreviatus L.

Wolcott 35-44: a summary of the diapause paper.

Wolcott, G. N., "The Life History of *Diaprepes abbreviatus* L. at Rico Piedras, Puerto Rico." Jour. Agr. Univ. P. R., **20**(4): 883-914, fig. 5, tab. 3, ref. 21. San Juan (October 1936), January 1937.

Wolcott 37-41: summary of the above.

Wolcott 37-53: adults killed by "Dutox" (barium fluosilicate) dusted on foliage.

Wolcott 37-81: comparative scarcity in pellets of excrement of *Bufo marinus* L.

Fife: 39-10: adults eat cotton leaves.

adults eating leaves of unidentified tree, Mona Id. (212-40); of *Cedrèla odorata* at Rio Grande (368-40), at Villalba (404-40); of *Conocarpus erectus* at Boca de Cangrejos (374-40); of young ratoon cane at Isabela (35-39); of espino rubiál, *Zanthoxylum caribaeum,* at Isabela (311-39). Eggs between leaves of caimito at Camuy (30-36). Larvae attacking mahogany seedlings, Mountain Top Nursery, Patillas (12-39).

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Lachnopus coffeae Marshall

adults feeding on grapefruit leaves (I No. 7212); in fruit fly traps (I No. 6820, 6855, 6980).

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Lachnopus curvipes F.

Fife 39-10: adults eat cotton leaves.

adults eating flowers and young fruit of cultivated grape at Ponce (41-39); on eggplant at Morovis (I No. 7399); at light at Guajataca (166-40).

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Lachnopus seini Wolcott

on *Rapanea ferruginea* at Aibonito (190-40).

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Lachnopus kofresi new species

Integument entirely black: no scales; short, silvery hairs on tibiae and tarsi, also towards apex of elytra, with an elongated tuft of longer hairs on the lateral margin at the posterior declivity. Considerably more robust than *Lachnopus curvipes, coffeae* or *bellus,* elytra broadest at middle; striae deep and regular, with deep regular punctures. Prothorax lightly and irregularly punctured, head almost impunctate. Length 26 to 38 mm., width 11 to 17 mm.

Described by G. N. Wolcott from 22 specimens collected by L. F. Martorell, August 8, 1939 (P. R. Acc. No. 129-39) from the underside of leaves of cultivated eggplant, Mona Island.

Named for an infamous pirate who made Mona Island his headquarters.

Apodrusus argentatus Wolcott

(as *Apodrosus*) Fife 39-10: adults eat cotton leaves.

on shoots of *Colubrina colubrina,* Mona Id. (283-40 det. as "near" L. L. Buchanan).

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Geraeus sp.—det. L. L. Buchanan

adults abundant on flowers of *Helichrysum bracteatum* at Villalba (414-40), of *Borreria verticillata* at Matrullas Dam (310A-39); also includes "*Centrinus* sp.—det. L. L. Buchanan, at Villalba (I No. 5151) on leaves of ? tree (Oakley)."

Anacentrinus sp.—det. L. L. Buchanan

on wild parsnip flowers at Cayey (30-39).

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Rhaptinus (Baris) torquatus Olivier

on *Solanum verbascifolium* at Aguas Buenas (I No. 7461); on *Solanum torvum* at Mayaguez (I No. 6095, 6944).

Diorymerellus obliteratus Champion

(as "near") Anon 39-119: a pest of vanilla.

on vanilla at Maricao (36-38).

Chalcodermus sp.

Fife 39-10: adults eating cotton leaves.

page 309

Pantophthalmus puertoricanus Buchanan, L. L., "A New Genus and four new Species of West Indian Cucrculionidae (Coleoptera)." Mem. Soc. Cubana Hist. Nat., **10**(3): 145-152. Habana, 1936: p. 147, TYPE from P. R.

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Anchonus anguilicollis Chevrolat

under bark of dead tree on El Yunque (344-39).

Anchonus sp.—det. L. L. Buchanan

from grapefruit at Bayamon (I No. 6433).

Cossonus canaliculatus F.

under bark and chips of wood of almácigo at Salinas (33-36 det. L. L. Buchanan); at Mayaguez (I No. 6372 as "sp.").

Stereoderemus sp.—det. L. Buchanan

in decaying wood at Mayaguez (I No. 6389).

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Metamasius hemipterus L.

Wolcott 37-82: five adults in one pellet of excrement of *Bufo marinus* L., collected in cane field at Vega Baja.

Wolcott 40-30: in maga pods.

adults in sugar-cane at Manati (I No. 6068); under pine-apple plant at Mayaguez (I No. 6947).

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Cosmopolites sordidus Germar

Wolcott 35-142: summarizing the work of F. Sein.

Wolcott 37-48: reporting experiments by Mr. Sein, no sign of infestation yet in plants from either pared or sterilized corms.

Wolcott 37-58: very light infestation after first year.

Wolcott 38-90: infestation had not increased by the second year to the point of seriously affecting yield.

Anon 38-101: the Histerid predator, *Plaesius javanus* Erichson, introduced from Fiji, released in P. R.

Anon 39-109: not recovered in P. R. A native earwig, *Psalis americana,* found in tunnels and fed upon the larvae of the weevil in captivity.

from plantain corms at Mayaguez (I No. 6059, 6060).

Calendra linearis Herbst

in tamarind seed pods (I No. 6522, 6089), at Arecibo (I No. 6076).

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SCOLYTIDAE

Stephanoderes brazilensis Hopkins

from grapefruit at Bayamon (I No. 6418).

Stephanoderes busckii Hopkins

in pods of algarrobo, *Hymanaea courbaril* (I No. 5905), at Arecibo (I No. 5958); in tamarind pods (I No. 6515).

Stephanoderes near *ferrugineus* Hopkins—det. M. W. Blackman

in pods of *Thespesia populnea* at Guayanilla (32-39).

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Hypothenemus near *parvus* Hopkins
in orange fruit, Mayaguez (I No. 5950).

Coccotrypes rollinae Hopkins—det. M. W. Blackman
in seeds of *Neowashingtonia robusta* palm (4-33).

Pseudothysanoes (not *Peudothysantes*) Blackman

Xyleborus affinis Eichoff
(as "sp.") Wolcott 37-62: appearing in lesions on *Inga vera* and *Inga laurina* caused by water-soluble salts of thallium in hormiguilla bait.

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DIPTERA

Johannsen, O. A., "New Species of Nemocera from Puerto Rico." Jour. Agr. Univ. P. R., **22**(2): 219-225. San Juan, May 1938.

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TIPULIDAE

Alexander, C. P., "New or little-known Species of West Indian Tipulidae (Diptera) II." Jour. Agr. Univ. P. R., **21**(2): 179-190, pl. 1. San Juan (July) April 1937.
"New or little-known Species of West Indian Tipulidae (Diptera) IV." Jour. Agr. Univ. P. R., **23**(2): 91-130, pl. 2. San Juan (September 7) April 1939.

Dolichopeza (Megistomastix) acutiloba Alexander 37-179: TYPE from El Yunque, P. R. (Garcia-Diaz).
Garcia-Diaz 38-95: listed.

Dolichopeza (Megistomastix) obtusiloba Alexander 37-180: TYPE from El Yunque, P. R. (Garcia-Diaz).
Garcia-Diaz 38-95: listed.

Limonia (Limonia) hoffmani Alexander
Alexander 39-108: at Villalba (W. A. Hoffman).

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Limonia (Neolimonia) diva Schiner
Garcia-Diaz 38-95: listed.

Limonia (Dicranomyia) brevivena Osten Sacken
Garcia-Diaz 38-95: listed.

Limonia (Dicranomyia) divisa Alexander
Alexander 39-113: at Villalba (W. A. Hoffman).

Limonia (Dicranomyia) distans Osten Sacken
Garcia-Diaz 38-95: listed.

Limonia (Rhipidia) domestica Osten Sacken
Garcia-Diaz 38-95: listed.
Alexander 39-113: at Villalba (W. A. Hoffman).

Limonia (Rhipidia) tetraleuca Alexander 37-182: TYPE from El Yunque, P. R.
Garcia-Diaz 38-95: listed.

Limonia (Geranomyia) antillarum Alexander
Garcia-Diaz 38-95: listed.
Alexander 39-113: at Villalba (W. A. Hoffman).

Limonia (G.) myersiana Alexander
Alexander 39-113: at Villalba (W. A. Hoffman).

Limonia (G.) subrecisa Alexander—det. C. P. Alexander
Garcia-Diaz 38-95: listed.

Limonia (G.) tibialis Loew
Alexander 39-113: at Villalba (W. A. Hoffman).

Limonia (G.) virescens Loew
Alexander 39-116: at Villalba (W. A. Hoffman).

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Helius (Helius) albitarsis Osten Sacken
Garcia-Diaz 38-95: listed.

Polymera (Polymera) geniculata Alexander
Garcia-Diaz 38-95: listed.

Shannonomyia hoffmani Alexander, C. P., "New or little-known Species of West Indian Tipulidae (Diptera) I." Jour. Agr. Univ. P. R., **20**(4): 877-882, fig. 4. San Juan (January 1937) October 1936: TYPE from El Yunque, P. R.

Shannonomyia leonardi Alexander
Garcia-Diaz 38-95: listed.

Shannonomyia triangularis Alexander
Garcia-Diaz 38-95: listed.

Hexatoma (Eriocera) trifasciata Roeder
Garcia-Diaz 38-95: listed.
Alexander 39-126: from El Yunque (Garcia-Diaz) and Las Mesas (A. H. Madden).

Gnophomyia (Gnophomyia) diazi Alexander 37-184: TYPE from El Yunque, P. R.
Garcia-Diaz 38-95: listed.

Gonomyia (Lipophleps) bicornuta Alexander
Garcia-Diaz 38-95: listed.

Gonomyia (L.) bifiligera Alexander
Alexander 39-128: at Villalba (W. A. Hoffman).

Gonomyia (L.) monacantha Alexander 37-184: TYPE from Vieques Id., others from Lares, Rio Blanco and Rio Yunez, P. R.
Garcia-Diaz 38-95: listed.

Gonomyia (L.) orthomera Alexander 37-185: TYPE from Tanama River, P. R., others from Cidra.
Garcia-Diaz 38-95: listed.

Gonomyia (L.) pleuralis Williston
Garcia-Diaz 38-95: listed.

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Gonomyia (L.) subterminalis Alexander
Garcia-Diaz 38-95: listed.

Teucholabis (Teucholabis) portoricana Alexander 37-180; TYPE from Villalba, P. R.
Alexander 39-126: quoting from the above.

Trentepholia (Paramongoma) niveitarsis Alexander
Garcia-Diaz 38-95: listed.

Erioptera (Mesocyphona) caloptera Say
Garcia-Diaz 38-95: listed.

Erioptera (Mesocyphona) portoricensis Alexander
Garcia-Diaz 38-95: listed.

Toxorhina (Toxorhina) fragilis Loew
Garcia-Diaz 38-95: listed.

BLEPHAROCERIDAE

Paltostoma argyrocincta Curran
Johannsen 38-223: from El Yunque and Rio Sabana.

PSYCHODIDAE

Maruina hirta Johannsen 38-224: TYPE from Rio Guaynabo, others from Rio Yunez, P. R.

CHIRONOMIDAE

Pentaneura marmorata Johannsen 38-219: TYPE from Rio Cidra, P. R.

Pentaneura monilis L. var. **peleensis** Walley
Johannsen 38-220: at Laguna Tortuguero.

Coelotanypus insulanus Johannsen 38-220: TYPE from Rio Yunez, P. R.

Coelotanypus concinnus Coquillett
Johannsen 38-220: at Cartagena Lagoon.

Cardiocladius obscurus Johannsen
Johannsen 38-220: at Cartagena Lagoon.

Cricotopus aberrans Johannsen 38-220: TYPE from Rio Tanamá, P. R., others from Rio Yunez and Rio Caguitas.

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Cricotopus conformis Curran
Johannsen 38-221: at five P. R. localities.

Cricotopus insolitus Curran
Johannsen 38-221: at four P. R. localities.

Corynoneura (Thienemaniella) similis Malloch
Johannsen 38-221: at Rio Yunez and Rio Cidra.

Pseudochironomus fulviventris Johannsen
Johannsen 38-221: from Rio Yunez and in Luquillo Mts.

Chironomus (Stenochironomus) furcata Johannsen 38-221: TYPE from Luquillo Mts., P. R.

Chironomus bulbosa Garry
Johannsen 38-222: at Cartagena, Guanica and Tortuguero Lagoons and from Rio Yunez.

Tanytarsus (Rheotanytarsus) meridionalis Johannsen 38-222: TYPE from Rio Yunez, P. R., others from five P. R. localities.

CERATOPOGONIDAE

Culicoides furens Poey
on Culebra Id., December 1937 (W. A. Hoffman).

Ceratopogon (Brachypogon) impar Johannsen 38-223: TYPE from El Yunque, P. R.

Atrichopogon sp.—det. Alan Stone
on cactus blossoms at Barceloneta (I No. 6593).

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CULICIDAE

Tulloch, G. S., "The Mosquitoes of Puerto Rico." Jour. Agr. Univ. P. R., **21**(2): 137-167, fig. 9, ref. 26. San Juan, April 1937.

"The Brackish Water Mosquitoes of Puerto Rico." Jour. Agr. Univ. P. R., **21**(4): 581-583. San Juan (November 12) October 1937.

"Ecological Notes on Mosquitoes Associated with Bromeliads." Jour. Agr. Univ. P. R., **22**(4): 499-501, tab. 1. San Juan (March 23, 1939) October 1938.

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Chaobrus festivus Dyar & Knab—det. R. Matheson
Garcia-Diaz 38-95: listed.

Chaobrus brasiliensis Theobald—det. G. S. Tulloch
Tulloch 37-153: the first record for the West Indies.

Corethrella appendiculata Grabham
Tulloch 37-153: predaceous on *Culex larvae.*
Tulloch 39-500: in bromeliads.

Wyeomyia mitchellii Theobald
Tulloch 37-141: in bromeliads in the mountains.
Tulloch 39-500: "larvae - - - are bright yellow and have slightly flattened bodies."

Anopheles albimanus Wiedemann
Tulloch 37-152: "most abundant."
Tulloch 37-582: in brackish water.
on Culebra Id., December 1937 (W. A. Hoffman).

Anopheles grabhamii Theobald
Tulloch 37-153: "second in abundance."
Tulloch 37-582: in brackish water.

Anopheles crucians Wiedemann—det. G. S. Tulloch
Tulloch 37-153: a single record from Guanica Lagoon.
Tulloch 37-582: in brackish water.

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Anopheles vestitipennis Dyar & Knab
Tulloch 37-153: only adults.

Megarhinus portoricensis Roeder
Tulloch 37-151: in tree holes and bromeliads.
Tulloch 39-500: in bromeliads at Maricao, elev. 2,000 ft.

Uranotaenia loewii Theobald
Tulloch 37-151: in water containing much vegetation.

Uranotaenia sapphirina Osten Sacken
Tulloch 37-151: rare.
(as "sp." or "spp.") Tulloch 37-582: in brackish water.

Psorophora jamaicensis Theobald
Tulloch 37-143: in temporary surface pools.

Psorophora pygmaea Theobald—det. G. S. Tulloch
Tulloch 37-142: fairly common on the south coast of P. R.
Tulloch 37-582: in brackish water.

Mansonia indubitans Dyar & Shannon—det. G. S. Tulloch
Tulloch 37-146: the first record for the West Indies.

Mansonia titillans Walker
Tulloch 37-146: at Mayaguez.

Aëdes (Stegomyia) aegypti L.
Tulloch 37-145: around dwellings.
on Culebra Id., December 1937 (W. A. Hoffman).

Aëdes condolescens Dyar & Knab
Tulloch 37-145: at Mayaguez.

Aëdes mediovittatus Coquillett
Tulloch 37-144: in tree holes.

Aëdes nubilis Theobald—det. G. S. Tulloch
Tulloch 37-143: at Dorado.

Aëdes scapularis Rondani—det. G. S. Tulloch
Tulloch 37-146: at Mayaguez.

Aëdes sollicitans Walker
Tulloch 37-143: at Guanica Lagoon.
Tulloch 37-500: "the salt-marsh mosquito," in salty or alkaline pools, even far from the ocean.

Aëdes taenorynchus Wiedemann
Tulloch 37-144: in the coastal plain.
Tulloch 37-582: in brackish water.

Aëdes tortilis Theobald—det. G. S. Tulloch
Tulloch 37-143: prefers higher altitudes.

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Culex bahamensis Dyar & Knab
Tulloch 37-148: "restricted to brackish water."
Tulloch 37-582: in brackish water.

Culex habilitator Dyar & Knab
Tulloch 37-149: in either fresh or brackish water.
Tulloch 37-582: in brackish water.

Culex secutor Theobald
Tulloch 37-150: in cool pools.

Culex nigripalpus Theobald
Tulloch 37-149: most abundant of all tropical *Culex*.
Tulloch 37-582: in brackish water.

Culex fatigans Wiedemann
(as *C. quinquefasciatus* Say) Tulloch 37-150: "most abundant in towns and cities."
on Culebra Id., December 1937 (W. A. Hoffman); at Bayamon (I No. 6900, 6901).

Culex pilosus Dyar & Knab
Tulloch 37-147: at Mayaguez.

Culex carcinophilus Dyar & Knab—det. G. S. Tulloch
Tulloch 37-148: at Cartagena Lagoon.

Culex americanus Neveu-Lemaire—det. G. S. Tulloch
Tulloch 37-148 and Tulloch 39-500: in bromeliads.

Culex janitor Theobald—det. G. S. Tulloch
Tulloch 37-150: in crab holes.

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Culex atratus Theobald
Tulloch 37-148: in permanent pools.
Tulloch 37-582: in brackish water.

Culex inhibitator Dyar & Knab
Tulloch 37-147: "most abundant of the Culex group."
Tulloch 37-582: in brackish water.

Culex antillum-magnorum Dyar
Garcia-Diaz 38-95: listed.

Deinocerites cancer Theobald
Tulloch 37-147: in crab holes.

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MYCETOPHILIDAE

Sciara sp.
at Guajataca in February (22-39), and in October and November, det. as all females — can not be identified" Elizabeth G. Fisher.

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CECIDOMYIDAE

Cecidomyia coccolobae Cook
making small cone-shaped galls in leaves of *Coccolobis uvifera,* Mona Id. (220-39).

BIBIONIDAE

Dilophus spinipes Say—det. Alan Stone
on guamá flowers at Cayey (127-40).

Dilophus sp. (not *spinipes*)—det. Alan Stone
on flowers of *Borreria verticillata* at Guajataca Dam (141-40).

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STRATIOMYIDAE

Hermetia albitarsis F.
in fruit fly trap (I No. 6966).

Hermetia illucens L.
abundant in fruit fly traps (I No. 6924); larvae in decayed grapefruit at Bayamon (I No. 6211); at Guajataca (288-39).

Neorondania sp. nov.—det. C. T. Greene
in fruit fly trap (I No. 6925).

Neorondania chalybea Wiedemann
on house screens, Mona Id. (133-39 det. C. T. Greene, 269-40); larvae under dead bark of yuma palm, *Cocotrynax argentea* (152-40 det. C. T. Greene).

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TABANIDAE

Dr. J. C. Bequaert, in preparing his paper on "The Tabanidae of the Antilles," Revista de Entomologia, **11**(1-2): 253-369, fig. 33. Rio de Janeiro, June 1940, examined and re-determined many of the specimens in the Station collection.

Chrysops variegata DeGeer
on grapefruit (I No. 7134); in citrus grove (556-17 det. J. C. Bequaert); on horses in coconut grove by ocean at Añasco (1028-13 det. J. C. Bequaert).

Leptiselaga crassipes F.—det. J. C. Bequaert
vanVolkenberg 39-: at Lake Guanica.
at San German (L. E. Gregory).

Tabanus hookeri Knab 15-48: TYPE from Mayaguez, P. R.
on the beach at Pt. Cangrejos (GNW—det. J. C. Bequaert).

Tabanus nervosus Curran (not *nervous*)
(as *Tabanus psamophilus* Osten Sacker det. C. T. Greene) IP-214: on the beach, resting on dry seaweed, as which it is the same color, and in which the larvae live, feeding on sand fleas, at Pt. Cangrejos (114-15 re-determined J. C. Bequaert), at Vega Baja (493-16).

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Tabanus caribaeorum Bequaert 40-323: TYPE from Grand Cayman, others from Mona Id. (L. F. Martorell). Illustration.

Tabanus stigma F.
from the beach at Cataño (unlabeled specimens—Leonard & Mills—det. J. C. Bequaert); on Mona Id. (204-39 det. Alan Stone).

Tabanus truquii Bellardi (= *T. lineola* from P. R.)
at San Juan

Tabanus brunettii Bequaert (= *Silvius punctipennis* Brunetti)
at Yauco (I No. 5570 det. as *Stenotabanus* sp. by Alan Stone).

Stenotabanus sp. nov. ?— det. Alan Stone
at Bayamon (I No. 6949), at Manati (I No. 6889).

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BOMBYLIIDAE

Hyperalonia cerberus F.
on Mona Id. (121-39).

Spongolostylum sp., near *pluto* Wiedemann
on Mona Id. (197-39 det. C. T. Greene).

Heterostylum ferrugineus F.
in cave on Mona Id. (161-39).

page 339
Exoprosopa sp. near *dodrans* Osten Sacken
on Mona Id. (196-39 det. C. T. Greene).

Anthrax gorgon F.
at the airport, Mona Id. (160-39, 221-40 det. C. T. Greene).

Anthrax lucifer F.
Jepson 36-21: abundant at Guanica.
at Ponce (293-39).

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ASILIDAE

Atomosia incisularis Macquart
at Bayamon (I No. 6871).

Ommatius marginellus F.
on Mona Id. (198-39 det. C. T. Greene).

page 341
Allopogon danforthi Curran, C. H., "New American Asilidae (Diptera)." Amer. Mus. Novitates **806**: 1-12. New York, 1935: p. 8, TYPE from P. R.

Proctacanthus rufiventris Macquart
in cane field at Aguadilla (41-38), at Loiza (289-39), at Salinas (290-39).

Plesioma sp. near *indecora* Loew
on Mona Id. (190-39 det. C. T. Greene).

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DOLICHOPODIDAE

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Psilopus melampus Loew—det. C. T. Greene
on weeds at Mayaguez (I No. 7423).

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Psilopus portoricensis Macquart
on weeds at Mayaguez (I No. 7423).

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PHORIDAE

Megaselida sp. "very close to *fungicola* Coq."—det. C. T. Greene
on polypore fungus (I No. 6143).

Megaselida scalaris Loew
from rotten silk of sweet corn at Mayaguez (I No. 6014); from rotten fruit of *Annona glabra* at Palo Seco (I No. 6514); at Adjuntas (I No. 6786).

Pseudaceton antiguense Crawford
Smith 36-839: from nest of *Solenopsis geminata* in mountains east of Mayaguez.

Syneura cocciphila Coquillett
from *Crypticeryia rosae* R. & H., on casuarinas at Ponce (32-37).

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SYRPHIDAE

Baccha clavata F.
Fife 39-9: larvae predaceous on *Aphis gossypii.*

Baccha conformis Loew
on Mona Id. (189-39 det. C. T. Greene, 271-40).

Baccha fasciatus Roeder
resting on sugar-cane at Salinas (372-39); on Mona Id. (270-40).

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Baccha latiusculus Loew
at Mayaguez (I No. 7298).

Baccha parvicornis Loew
(32-40, I No. 6952), in fruit fly trap (I No. 6936).

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Allograpta limbata F.
on Mona Id. (272-40).

Volucella horvathi Szilady—det. C. T. Greene
flying in shade of trees, Mona Id. (134-39).

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Volucella tricincta Bigot
in fruit fly trap at Mayaguez (I No. 6945).

Eristalis vinetorum F.
(I No. 6792), at Loiza (I No. 6795), at Palo Seco (I No. 6798); frequenting flowers of *Borreria verticillata* at Aguadilla (252-39), at Yabucoa.

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CONOPIDAE

Physocephala sp.—det. D. G. Hall
frequenting flowers of *Borreria verticillata* at Yabucoa (239-39), at Palo Seco (54-40); a pair in coitu on citrus at Isabela (120-32); on cane leaf at Ceiba (303-39).

Conops sp. "near *xanthopareus* Williston"—det. C. T. Greene
at Bayamon (I No. 6038).

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TACHINIDAE

Tricopoda pennipes F. (not *Trichopoda*)
in fruit fly trap at Mayaguez (I No. 7277); frequenting flowers of *Borreria verticillata* at Yabucoa (314-39 det. D. G. Hall).

Lydella stabulans var. **grisescens** Rond.—Introduced
Anon 38-96: not recovered from *Diatraea saccharalis* larvae.

page 354

Cryptomeigenia aurifacies Walton
Jepson 36-5 and 12: "common in the wetter parts of the Island" but scarce when he came to look for it.

page 355

Lixophaga diatraeae Townsend
Anon 38-96: a high of 31.9% parasitism of larvae of *Diatraea saccharalis* F. at Hormigueros (K. A. Bartlett).
Anon 39-97: reared and re-distributed in the field.

Theresia claripalpis van der Wulp—Introduced
Dohanian 37-241: collected in Peru for release in P. R.
Anon 38-96: not recovered.
Anon 39-96: reared in laboratory in P. R.

Eutrixoides jonesii Walton
Jepson 36-6: "a rarer species."

Leskiopalpus diadema Wiedemann—Introduced
(as *Stomatodexia*) Dohanian 37-239: from Demerara.
Anon 38-96: not recovered.

Metagonistylum minense Townsend—"The Amazon Fly"—Introduced
Dohanian 37-238: material collected and reared in Demerara.
Anon 38-96: not recovered in P. R.
Anon 39-95: recovered at Santa Isabel.
Bartlett, K. A., "The Second Introduction of the Amazon Fly from British Guiana into Puerto Rico." Agr. Notes **86**, pp. 4. Mayaguez, November 14, 1938. (Mimeographed.)

page 358

Frontina bigeminata Curran
from almendra fruits at Vega Alta (I No. 5952 as *Achaetoneura*).

page 360

Archytas analis F.
in cane field at Ceiba (302-39).

Archytas piliventris van der Wulp
at Mayaguez (I No. 5954).

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SARCOPHAGIDAE

page 362

Sarcophaga lambens Wiedemann (= *S. sternodontis* Townsend)
Fife 39-6: parasitizing *Heliothis virescens* and *Alabama argillacea.*
reared from dead tobacco hornworm caterpillars (384-39 det. D. G. Hall).

Sarcophaga currani Hall—det. D. G. Hall
in cave on Mona Id. (124-39).

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Sarothromyia femoralis Schiner
at light, Mona Id. (374-39 det. D. G. Hall).

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MUSCIDAE

Cochliomyia macellaria F.
reported as so abundant and troublesome on Mona Island as to prevent drying of fish on the beach: no specimens.

Morellia scapulata Bigot
on grapefruit at Barceloneta (I No. 6791).

page 366

Musca domestica L.
Anon 38-100 and Bartlett 39-6: host of *Spalangia philippinensis* Fullaway in breeding work.
Anon 39-100: parasitized by *Dirhinus giffardii* Silvestri in laboratory.
Anon 39-107: parasitized by *Muscidifurax raptor* Gir. & Saunders.
on Mona Id. (203-39 det. D. G. Hall, 208-39, 44-40).

page 367

Haematobia irritans L.
Anon 39-107: host of *Spalangia philippinensis* from Hawaii.
Bartlett, K. A., "The Introduction into Puerto Rico of Beneficial Insects to aid in the Control of the Horn Fly of Cattle." Agr. Notes **88**, pp. 6. Mayaguez, March 31, 1939. (Mimeographed.)

page 368

ANTHOMYIIDAE

Atherigona excisa Thomson
from cashew fruit at Bayamon (I No. 7241 as "sp.").

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BORBORIDAE

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Leptocera discalis Malloch
at Adjuntas (I No. 4061, 6789).

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SAPROMYZIDAE

Carpolonchaea pendula Bezzi
at Mayaguez (I No. 5944); on Mona Id. (184-39 det. D. G. Hall).

page 372

Minettia aibonito Curran
at Guayama (I No. 6793).

Minettia slossonae Coquillett
at Adjuntas (I No. 4037, 6787), at Juncos (I No. 6796).

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ORTALIDAE

Xanthacrona bipustulata van der Wulp
at Mayaguez (I No. 7106).

Macrostenomyia guerini Bigot
in fruit fly trap at Mayaguez (I No. 6965).

Stenopa sp.—near *Neoacantheneura* sp.
in fruit fly trap at Mayaguez (I No. 6964).

page 374

Euxesta eluta Loew
in silk of sweet corn at Mayaguez (I No. 6013).

Euxesta stigmatias Loew
App, B. A., "*Euxesta stigmatias* Loew, an Otitid Fly infesting ear corn in Puerto Rico." Jour. Agr. Univ. P. R., **22**(2): 181-188, pl. 1. San Juan, May 1938.
Anon 39-65: "most prevalent - - - - in sweet corn."
reared from rotten corn (I No. 6485, 6581, 7156, 7157, 7169).

Euxesta thomae Loew
in fruit fly traps (I No. 6968, 6988).

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Chaetopsis fulvifrons Macquart
reared from guava fruit at Naguabo (I No. 6718 as "sp.").

TRYPETIDAE

Toxotrypana curvicauda Gerstaecker
reared from papaya (I No. 5960, 5961), at Bayamon (34-39), at Guayama (I No. 6475).

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Anastrepha sp. nov. "F"—det. Alan Stone
in fruit fly traps at Mayaguez (I No. 6963, 7045).

Anastrepha mombinpraeoptans Sein (= *A. acidusa* Walker)
(as *A. acidusa* Walk.) Anon 36-32: laboratory maintained at Mayaguez, to study.

(as "sp.") Anon 37-101: studied by L. C. McAlister, Jr., and J. W. Balock.

(as "sp. probably *A. mombinpraeoptans* Sein") Anon 38-79: larvae in mango fruits killed by desiccation.

Anon 38-96: parasites reared by K. A. Bartlett.

reared from pomarrosa fruits (I No. 7301), at Las Mesas (I No. 5995); hybrids from pomarrosa fruits (I No. 7292); from *Spondias ciruela* fruits at Arecibo (I No. 6670); from jobo fruits at Arecibo (I No. 6200, 7336), at Caguas (I No. 6293, 6588, 6294), at Cayey (I No. 6334), at Patillas (I No. 7332); from mango fruit at Bayamon (I No. 6524, 6478), at Guaynabo (I No. 6498), at Rio Piedras (I No. 6489), at Coamo (I No. 6497), at Guayama (I No. 6479), at Aibonito (I No. 6622), at Mayaguez (I No. 5994); from guava fruits at Naguabo (I No. 6717), at Bayamon (I No. 6645); from cashew fruits at Dorado (I No. 6574, 6583); from grapefruit at Manati (I No. 6685), at Garrochales (I No. 7313, 7314), at Arecibo (I No. 7292).

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Anastrepha unipuncta Sein (= *A. suspensa* Loew)

(as "sp.") Anon 37-101: studied by L. C. McAllister, Jr. and J. W. Balock.

(as *A. suspensa* Loew) Anon 36-32: laboratory maintained at Mayaguez, to study.

(as *A. suspensa* Loew) Bartlett 39-3: host of *Spalangia philippinensis* Fullaway in breeding work.

reared from black heart cherry fruits, infected in the laboratory (I No. 7288, 7289); from grapefruit at Rio Piedras (I No. 6935, 7222, 6889, 6878, 6885), at Bayamon (I No. 6004, 6005, 6934, 6879, 7176, 7226, 7227, 7434), at Vega Alta (I No. 7213, 7223, 7235, 7431, 7446), at Vega Baja (I No. 6932, 7261), at Manati (I No. 6682, 6933, 7223), at Arecibo (29 interception records), at Barceloneta (I No. 7231), at Las Marias (I No. 5949, 6465), at Adjuntas (I No. 6447), at Juana Diaz (I No. 5974, 5983, 6407, 6461), at Aguada (I No. 6457), at Añasco (I No. 6387, 6268), at Mayaguez (I No. 5951, 6452, 6455, 6464, 6851, 6713, 6714, 6729, 6772); from orange at Lares (I No. 5973, 6458), at Guayanilla (I No. 5479), at Ponce (I No. 5978); from sour orange fruits at Mayaguez (I No. 6799, 6451, 6463), at Maricao (I No. 6453, 6460), at Las Marias (I No. 6454), at San Sebastian (I No. 6456, 6465), at Adjuntas (I No. 5879, 5901, 5930, 5982, 6462), at Yauco (I No. 5980), at Ponce (I No. 5981, 6467), at Juana Diaz (I No. 5975, 5984, 6009, 6001, 6003, 6053, 6232, 6262, 6459); from *Spondias dulcis* fruits (I No. 6632); fifteen interception rearings from fruits of guava, *Psidium guajava*, at Bayamon, at Palo Seco (I No. 6638), at Rio Piedras (I No. 6643), at Caguas (I No. 6292, 6659, 6660), at Vega Alta (I No. 6663, 6664, 6665, 6251,

6252), at Vega Baja (I No. 6519, 6641, 6667), at Arecibo (I No. 6181, 6200, 6283, 6666), at Aguadilla (I No. 6443), at Sabana Grande (I No. 5962, 5963), at Naguabo (I No. 6717); from fruits of almendra, *Terminalia catappa,* at Bayamon (I No. 6608), at Corozal (I No. 6607), at Dorado (I No. 6619, 6621, 7023), at Manati (I No. 6609), at Arecibo (I No. 6070, 6217, 6354, 6716, 6669, 6675, 7025); from fruits of pomarrosa, *Eugenia jambos,* at Bayamon (I No. 6525), at Caguas (I No. 6530), at Cayey (I No. 6562), at Las Marias (I No. 5005); from fruits and icaco, *Chrysobalanus icaco,* at Bayamon (I No. 6624); from fruits of malay apple, *Jambos malaccensis,* at Trujillo Alto (I No. 6595).

Tetraeuaresta obscuriventris Loew
on weeds, Mona Id. (302-40 det. C. T. Greene).

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EPHYDRIDAE

Ephydra gracilis Packard—det. D. G. Hall
Wolcott & Martorell 37-536: in salt lagoons at Guanica and Faro de Cabo Rojo.
including the AMC records as "sp. det. J. M. Aldrich, at Ensenada xi-26," and as "sp. nov. det. C. H. Curran, at Ensenada xi-26, Faro de Cabo Rojo i-31"; also, from salt lagoons at Ensenada (16-36), at Faro de Cabo Rojo (57-37).

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CHLOROPIDAE

"near *Meromyza*"—det. C. T. Greene
dark, elongated, diamond-shaped, scale-like larvae on leaves of sugar-cane, at Guanica (67-37), and at many other localities, especially on the south coast.

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DROSOPHILIDAE

Drosophila melanica Sturdevant ?—det. C. T. Greene
at Adjuntas (I No. 4057, 6788).

Drosophila repleta Williston (not Wollaston)
reared from grapefruit picked from tree at Barceloneta (I No. 7214).

Drosophila sp.
from ovary of flower of tibéy, *Isotoma longiflora,* at Vega Baja (I No. 7266).

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Leucophenga varia Walker—det. C. T. Greene
resting on sugar-cane at Coloso (332-39).

AGROMYZIDAE

Agromyza aeneiventris Fallen ?—det. C. T. Greene
on tender leaves of *Coccolobis laurifolia,* Mona Id. (43-40).

Agromyza caerulea Malloch
Bailey, W. K., and Plank, H. K., "An Agromyzid Fly Infesting Sweet-potato Seed in Puerto Rico." Jour. Ec. Ent., **33**(4): 704-5. Menasha, Wisconsin, August 1940.

page 391

Cryptochaetum iceryae Williston—Introduced
adults from shipment of parasitized cottony cushion scale from Whittier, California, released on Mona Id. (200-40).

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HIPPOBOSCIDAE

Dr. J. C. Bequaert has checked the following records and indicated generic transfers and synonymy.

Ornithoctona erythrocephala Leach
Coquillett: on sparrow hawk at Adjuntas and from Culebra Id.
Johnson, C. W., *in* Psyche **29**( ): 84. Cambridge, 1922: on *Falco sparverius.*
on *Gymnasio nudipes* (H. E. Anthony); on *Buteo borealis* at Mayaguez.

Olfersia aenescens Thompson (= *O. diomedeae* Coquillett—det. J. M. Aldrich = *O. erythropsis* Bigot)

Olfersia fossulata Macquart
on booby, *Sula leucogaster,* Desecheo Id. (S. T. Danforth).

Olfersia spinifera Leach—det. Alan Stone
on frigate bird, *Fregata magnificens,* Mona Id. (152-39), at Mayaguez (J. R. Ramos).

Lynchia albipennis Say (= *Olfersia albipennis* Say)

Pseudolynchia canariensis Macquart (= *Lynchia maura* Bigot)

STREBLIDAE

Dr. J. C. Bequaert notes the following records.

Paradyschira dubia Rudow
(as *P. fusca* Spesier—det. J. C. Bequaert) Anthony, H. E., "Mammals of Porto Rico, Living and Extinct." Scientific Survey of Porto Rico and the Virgin Islands, 9(1): 1-238, pl. 54. New York Academy of Sciences, New York, 1925: p. 18, on *Noctilio leporinus mastivus,* in cave, Piedra de la Cueva, Loiza Aldea.

Pterellipsis aranea Coquillett (not *araeneae*)
Anthony 25-39: on *Brachyphylla cavernarum,* det. J. C. Bequaert.
at Bayamon (Aug. Busck) det. J. C. Bequaert.

Trichobius dugesii Townsend
Jobling, J. W., *in* Parasitology, **30**( ): 383 (1938): from *Artibeus jamaicensis.*
at Bayamon (Aug. Busck) det. J. C. Bequaert.

Trichobius pseudotruncatus Jobling (= *T. kesselae* Jobling)—det. J. W. Jobling
from *Artibeus jamaicensis.*

Trichobius truncatus Kessel—det. J. W. Jobling
from *Artibeus jamaicensis.*

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SIPHONAPTERA

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ECHIDNOPHAGIDAE

Tunga penetrans L.
on man, Mona Id. (77-39).

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PULICIDAE

Ctenocephalus canis Curtis
on dog, Mona Id. (76-39).

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LEPIDOPTERA

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NYMPHALIDAE

Danaus menippe Hübner—det. C. Heinrich
reared from *Asclepias curassavica* at Corozal (I No. 7426).

Heliconius charitonius L.
on Mona Id. (168-39, 28-40), in gorge at Guajataca (67-38), in Peñon del Collao, Cayey (129-40).

Colaenis julia F.
in gorge at Guajataca (66-38).

page 398
Dione vanillae L.
on Mona Id. (26-40, 224-40).

Synchloe tulita Gundlach
in gorge at Guajataca (269-39).

page 399
Junonia genoveva Cramer
on Mona Id. (27-40); adults frequenting flowers of *Borreria verticillata* at Yabucoa (243-39).

Anartia jatrophae L.
adults very abundant in cane field at Salinas (249-39).

Eunica monima Cramer (not *Eunia*)
on Mona Id. (226-40).

Didonis biblis F.
adults at Faro de Cabo Rojo (54-37), at Salinas (304-39); larvae on leaves of pringamosa, *Tragia volubilis,* at Quebradillas, reared by Cesário Perez.

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Victorina steneles L.
at Peñon del Collao, Cayey (128-40).

Hypolimnas misippus L.
adults of both sexes abundant at Colonia Jauca, Salinas, October 1939 (321-39).

Historis orion F.
(73-37); adults feeding on exuding sap of dying *Inga vera* tree at Ciales (32-36).

page 401

SATYRIDAE

Calisto nubila Lathy
in mountains north of Yauco (277-39).

LYCAENIDAE

Lycaena filenus (= *L. hanno*) det. Wm. T. M. Forbes
larvae on buds, flowers and seeds of *Macroptilium lathyroides,* reared by Cesário Perez.

page 402

Lycaena theonus Lucas
Wolcott 35-144: summarizing rearing of larvae on buds and flowers of lima beans and *Crotalaria incana.*

Hemiargus sp. "near *zachaeina* B. & D."—det. C. Heinrich
on weeds, Mona Id. (244-40).

page 403

PIERIDAE

Pieris monuste L.
larvae very abundant on *Cleome gynandra,* from Guanica to Guayanilla (29-37), on Mona Id. (25-40) attacking onions when normal host was weeded out.

Phoebis agarithe Boisduval
larvae on *Pithecolobium dulcis,* reared by Cesário Perez.

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Phoebis statira neleis Boisduval—det. F. E. Watson
larvae on tender leaves of quenepa, *Melicoca bijuga* L. (12-36), in July 1936, June 1937 and September 1939.

page 405

Eurema portoricensis Dewitz

Watson 38-2: "the outer margin of the primary rounded, and both primary and secondary with a narrow black border."

Eurema sanjuanensis Watson, F. E., "A New Eurema from Puerto Rico." Amer. Mus. Novitates **971,** pp. 2. New York, April 25, 1938: TYPE from San Juan, P. R.

page 406

PAPILIONIDAE

Papilio pelaus F.

reared from larvae on grapefruit at Palo Seco (I No. 5968, 6012, "a new local race" det. Wm. Schaus).

HESPERIIDAE

Goniurus proteus L.

adults abundant at flowers of *Moringa moringa* and *Pisonia albida,* Mona Id. (227-40).

page 407

Acolastus amyntas F.

Anon 38-93: larvae feed on leaves of *Derris eliptica* (det. J. F. Gates Clarke).

page 408

Proteides idas Cramer

(as *P. pedro* det. Wm. Schaus) Anon 38-93: larvae feeding on leaves of *Derris eliptica* (H. K. Plank).

Hesperia syrichtus F.

on Mona Id. (163-39, 228-40).

page 409

Choranthus hübneri Plotz

male and female reared from larvae feeding on leaves of areca palm by F. Sein (70-38 det. as *Atrytone* by J. F. Gates Clarke).

Catia otho Abbott & Smith

at Mayaguez (I No. 5939, 5940 det. as "sp., to the *otho-resuria* group"); on Mona Id. (112-39, 229-40).

page 410

Lerodea tripunctata Herrich-Schaeffer

on Mona Id. (212-39).

Prenes ares Felder

on Mona Id. (212-39).

Prenes nero F.

(as *P. sylvicola* H. S.) at Mayaguez (I No. 5938).

page 412

Perichares corydon F.

Anon 39-118: larvae feed on leaves of bamboo at Mayaguez.

page 413

EUCHROMIIDAE

Eunomia rubripunctata Butler—det. J. F. Gates Clarke

at light, Mona Id. (243-40).

Cosmosoma auge L.

at light (15-39).

Horama panthalon F.

flying among weeds at Guayanilla (82-40).

Horama pretus Cramer

at light (I No. 6908); frequenting flowers of *Heliotropum indicum,* Vieques Id. (104-40); at Manati (339-39).

Empyreuma pugione L.

(I No. 6207, 6220); larvae on oleander (384-40).

Correbidia terminalis Walker

at light on El Yunque (40-39 det. J. F. Gates Clarke).

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ARCTIIDAE

Progona pallida Möschler

Garcia-Diaz 38-96: listed.

Ammalo insulata Walker

in cane field at Quebradillas (24-39); at lighthouse, Mona Id. (237-40).

Calidota strigosa Walker

adult hiding under loose bark on fence post, Mona Id. (24-40), other at light (230-40).

Ecpantheria icasia Cramer

Anon 38-93: larvae eating vanilla leaves (det. J. F. Gates Clarke).

egg-mass on *Cedrela odorata,* Villalba (346-40), and adults at light at Villalba (412-40).

page 417

PERICOPIDAE

Composia sybaris Cramer

adults abundant on Mona Id. (223-40).

page 418

NOCTUIDAE

[Schaus, Wm., "Insects of Porto Rico and the Virgin Islands—Moths of the Family Noctuidae." Scientific Survey of Porto

Rico and the Virgin Islands, **12**(2): 177-290. New York Academy of Sciences, New York, June 7, 1940.]

Lycangesia sp. nov.—det. Wm. Schaus
at light at Bayamon (I No. 6761).

Heliothis obsoleta F.
Anon 39-65: "the most serious handicap in the production of sweet corn."
Fife 39-6: not observed attacking cotton in P. R.
adult resting on sugar-cane, Ceiba (301-39); larvae eating pigeon peas (I No. 7355).

Heliothis virescens F.
Fife 39-6; larvae numerous on *Abutilon hirtum* at Guanica, Lajas and Boquerón, November 1935.

page 419
Feltia annexa Treitschke
Gage 39-22: a pest of tobacco.
larvae attacking cucumber plants (72-37), weeds on Mona Id. (213-39).

Feltia subterranea F.
Fife 39-6: attacking young seedling cotton at Boquerón, August and September 1937.
completely destroying three plantings of cotton at Boquerón (61-37).

page 420
Xanthopastis timais Cramer
larvae exceptionally abundant on spider amaryllis on the beach between Arecibo and Hatillo (335-39).

Cirphis latiuscula Herrich-Schaeffer
at Bayamon (I No. 6754).

page 422
Catabena esula Druce
common at light, Mona Id. (240-40 det. G. F. Gates Clarke).

page 423
Laphygma frugiperda Smith & Abbot
Anon 38-101: attacked by wasps (W. K. Bailey).
Anon 39-63 and 65: a pest of sweet corn.
Fife 39-6: rare of cotton.
larvae very abundant on young sugar-cane at Juana Diaz (7-37), at Guanica (37-37) and their remains present in excrement of *Bufo marinus* L.; on corn at Mayaguez (I No. 5953); on alfalfa at Isabela (49-38); attacking peppers (I No. 6683), at Isabela (I No. 6286); burrowing into gladiolus bulb (69-40).

page 425

Prodenia dolichos F.

Fife 39-6: rare on cotton.

Prodenia pulchella Herrick-Schaeffer

Fife 39-6: rare on cotton.

Prodenia ornithogalli Guenée

Anon 38-59: "serious damaged garden peas on Las Mesas."

page 426

Xylomiges sunia Guenée

(as *Laphygma*) Fife 39-6: rare on cotton.

page 427

Atethmia repanda F. (= *Bagisara inusta* Guené det. F. E. Watson)

at light at Bayamon (I No. 6760 det. as = *subusta* Hübner = *inusta* Guenée).

Cydosa nobilitella Cramer

at light (I No. 6769).

page 430

Paectes devincta Walker

at light at Bayamon (I No. 6025).

Stictoptera vitrea Guenée

at light at Bayamon (I No. 6024).

Charcoma nilotica Rogenhof

at light at Bayamon (I No. 6748).

page 431

Mocis repanda F.

adult at light (245-39); larvae abundant on young sugar-cane at Guanica (334-39)—not previously noted since 1932.

page 433

Phytometra oo Cramer

Gage 39-22: "on shade-grown tobacco."

Pseudohemiceras krugii Möschler

larvae boring in twigs of *Tabebuia heterophylla* at Guanica (337-40), of *T. pallida* at Maricao (385-40), of *T. lucida* and *heterophylla* on Mona Id. (316-40).

page 436

Melipotis acontioides Guenée.

Wolcott 35-143: an outbreak in Santurce and Hato Rey, August 1933.

adults resting on sugar-cane at Salinas (251-39); larvae defoliating flamboyánt at Guanica (35-37); larvae reared to adult from palo verde, *Parkinsonia aculeata*, at Faro de Cabo Rojo (53-37).

Melipotis januaris Guenée
at light at Bayamon (I No. 6021, 6022).

page 437
Thermesia gemmatilis Hübner
Wolcott, G. N. & Martorell, L. F., "Epidemics of Fungus Disease Control Insect Pests in Puerto Rico." Jour. Ec. Ent., **33**(1): 201-2. Menasha, Wisconsin, February 1940: outbreak at Isabela controlled by *Spicaria rileyi.*
at light at Bayamon (I No. 6023 det. as *Anticarsia*); defoliating cowpeas at Isabela (275-39).

page 438
Capnodes turtur Felder & Rogenhof
at light at Bayamon (I No. 6019 as *Massala*).

page 439
Sylectra erycata Cramer (not *Syllectra ericata*)
at light (222-39 det. J. F. Gates Clarke).

page 440
Anomis erosa Hübner
Fife 39-6: on *Sida cordifolia.*

Anomis illita Guenée
Fife 39-6: on *Malachra capitata.*

Alabama argillacea Hübner
Fife 39-5: the most important Noctuid attacking cotton in P. R.
Wolcott 40-29: the caterpillars do not feed on maga foliage.
on cotton 6 to 8 in. high, at Boquerón (63-37), on high cotton at Tallaboa (309-39) in October, at Patillas in November (347-39).

page 442
Trissophaes serpentinifera Walker—det. J. F. Gates Clarke
one adult at light at Guajataca (160-40), another at Camp Doña Juana, Villalba, April 30, 1940 (LFM & D. deLeon).

page 443
Mastigophorus dimissalis Möschler
at light at Bayamon (I No. 6753).

Epitomiptera orneodalis Guenée
Anon 39-118: larvae feeding on bamboo at Mayaguez.

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SPHINGIDAE

page 446
Phlegethontius s. jamaicensis Butler
Gage 39-22: "on nearly mature plants" of tobacco.
at light, Mona Id. (238-40).

Pseudosphinx tetrio L.
adults at light and larvae on *Plumiera alba,* Mona Id. (239-40).

page 449

Cautethia noctuiformis Walker
at light, Mona Id. (214-39).

Aellopos fadus Cramer
(I No. 6302, 6303).

Perigonia lusca F., var. **interrupta** Walker
at light at Bayamon (I No. 6018); larvae on *Duggena hirsuta* at Martin Peña, reared by Cesário Perez.

Celerio l. lineata F.
at light, Mona Id. (225-40).

page 450

GEOMETRIDAE

[Schaus, Wm., "Insects of Porto Rico and the Virgin Islands—Moths of the Families Geometridae and Pyralidae." Scientific Survey of Porto Rico and the Virgin Islands, **22**(3): 291-417. New York Academy of Sciences, New York, July 15, 1940.]

Scopula sp. nov.—det. W. Schaus
at light at Bayamon (I No. 6739).

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Pleuroprucha molitaria Möschler
at light at Bayamon (I No. 6751).

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EPIPLEMIDAE

Letchena myreusalis Walker—det. W. Schaus
at light at Bayamon (I No. 6752).

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PYRALIDAE

Desmia sp. nov.—Det. W. Schaus
at light at Bayamon (I No. 6758).

Maruca testulalis Geyer
Wolcott 37-56: not found in lima beans at Isabela, February to April 1936; abundant in snap beans the preceding autumn.
Anon 37-43: a limiting factor in dry bean production (L. B. Scott).
Wolcott 38-84: original host was the wild lima bean *Vicia faba* L., now most abundant in lima beans in autumn.
Anon 38-60: "approximately 85% of the entire borer population."

Latta, R., "Methyl Bromide Fumigation for Destruction of Pod Borer Larvae." Jour. Ec. Ent., **33**(1): 176-179. Menasha, Wisconsin, February 1940: experiments conducted at San Juan, P. R. Complete mortality of *Maruca* larvae at 0.5 pounds per 1,000 cu. ft., above 70° F. for 2 hours at atmospheric pressure, without injury to host.

abundant on lima beans at Isabela (40-36); in wild lima bean, *Vicia faba* L. (27-36).

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Synclera frondaria Guenée—det. W. Schaus & C. Heinrich

larvae eating shoots of *Tartago ematica* (I No. 7080, 7088).

Marasmia similis van Hedemann

injury of larvae to young cane leaves quite abundant at Aguadilla and Camuy (28-36).

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Pilocrocis lauralis Walker

at light at Bayamon (I No. 6026), on Mona Id. (215-39 det. C. Heinrich).

Mesocondyla concordalis Hübner

[Martorell, L. F., "Notes on the Biology of *Mesocondyla concordalis* Hübner, and its Parasites." Caribbean Forester, **2**(1): 18-19, fig. 1. New Orleans, La., October 1940.]

larvae on leaves of calabaza at Ponce (341-40); on leaves of roble at Maunabo (6-40), of *Tabebuia heterophylla* and *T. lucida* (det. L. R. Holdridge), on Mona Id. (279-40).

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Dichogamma amabilis Möschler

at light, Mona Id. (216-39, 241-40 det. C. Heinrich).

Dichogamma redtenbacheri Lederer

at light, Mona Id. (234-40).

Phostria simialis Guenée—det. W. Schaus

at light at Bayamon (I No. 6027).

Phostria originalis Lederer—det. W. Schaus

Martorell 39-25: a pest on moca.

larvae on moca, *Andira inermis*, at Aibonito and Barranquitas (47-36), at Cayey (91-40, 113-40).

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Lamprosema indicata F.

Anon 37-74: larvae feed on *Derris eliptica* (H. K. Plank).

Anon 38-92: control by hand-picking.

Anon 39-108: parasitized by *Chrysocharis* sp. and *Apanteles* sp.

Sylepta gordialis Guenée

larvae on leaves of 4 o'clock (I No. 6939, 6973).

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Margaronia phlegia Cramer (not *flegia*)

larvae on *Thevetia thevetia* at La Fortaleza, San Juan (2-37).

Margaronia aurocostalis Guenée

at light, Mona Id. (167-39, 232-40).

Margaronia hyalinata L.

Anon 38-59: "seriously damaged calabaza plantings on Las Mesas, and muskmellon and cucumber plantings."

on pumpkin at Mayaguez (I No. 7364).

page 463

Agathodes designalis Guenée

larvae boring in terminal shoots and eating leaves of *Erythrina glauca* at Cayey (89-40).

Syllepsis martialis Poey

at light at Bayamon (I No. 6029).

page 464

Terastia meticulosalis Guenée

Anon 39-121: killing twigs of *Erythrina berteroana.*

larvae boring in twigs of capá blanco, *Petitia domingensis* at Maunabo (46-38), of *Erythrina berteroana* at Mayaguez (I No. 7012).

Crocidophora zinghalis Walker—det. H. G. Dyar (810-14).

Psara periusalis Walker

Gage 39-22: "often attacks young tobacco leaves."

on *Amaranthus* at Manati (I No. 7139).

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Psara bipunctalis F.

on *Amaranthus* at Manati (I No. 7141).

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Pyrausta cerata F.

larvae abundant on *Citharexylon fruticosum* at Yabucoa, Maunabo, Cayey, Bayamon Isabela, Aguadilla, Cabo Rojo and Guanica (51-37), at Maunabo, Patillas, Arroyo, Salinas and Cayey (5-40), at Cayey (110-40), at Guanica (78-40), at Quebradillas and Isabela (73-40) and at San Sebastian (72-40).

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Paraponyx rugosalis Möschler

(as *Nymphula*) Garcia-Diaz 38-96: listed.

page 469

Cataclyta sumptuosalis Möschler

(as *Argyractis*) Garcia-Diaz 38-96: listed.

GLAPHYRIINAE

Dicymolomia pegasalis Walker—det. C. Heinrich
on roble (I No. 6771).

ENDOTRICHINAE

Perforadix sacchari Sein
larvae boring in tender roots of sugar-cane at Adjuntas (276-39); adult at light at Bayamon (I No. 6763).

EPIPASCHIINAE

Pococera atramentalis Lederer
reared from flamboyánt buds (I No. 6974 det. as "?"), of almendra (I No. 6973).

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PYRALINAE

Herculia psammioxantha Dyar—det. C. Heinrich
larvae feeding on baled alfalfa hay, making it unsightly with webs, at Isabela (74-38).
According to Mr. Heinrich, in synonymy with Möschler's *Parasopia dissimilalis,* but not with *Pyralis manihotalis* Guenée.

page 471

SCHOENOBIINAE

Scirpophaga longicornis Möschler
at light, Mona Id. (211-39).

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CRAMBINAE

Diatraea saccharalis F. (not *saccharlis*)
Dohanian 37-237 to 241: parasites of, introduced from British Guiana and Peru.
Anon 38-96: introduced parasites not recovered, but a native parasite of the larva, *Lixophaga diatraeae* TT, with a high of 31.9% parasitism at Hormigueros, and *Bassus stigmaterus* Cresson with a high of 4.8% at Hormigueros in 1936.
Anon 39-97: parasites of, introduced.
Wolcott 38-98 to 101: initiation of observations on natural control by *Trichogramma.*
Wolcott 39-38 to 40: experimental releases of laboratory—reared *Trichogramma.*
Wolcott, G. N., "*Prophanurus alecto* Crawford in Puerto Rico." Jour. Ec. Ent., **32**(1): 152-3. Menasha, Wisconsin, February 1939: sporadic appearance of, as parasite in eggs of *Diatraea.*
pupae in stems of rice at Fajardo (I No. 6049); adult at light, Mona Id. (235-40).

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GALLERINAE

Corcyra cephalonica Stainton
Fife 39-7: in stored cotton seed.

PHYCITINAE

Hypsipyla grandella Zeller (not *Hypsiphyla*)
for "a shoot-borer in cedro hembra, *Turpinia paniculata*" read, "a shoot-borer in West Indian Cedar or 'cedro,' *Cedrela odorata*." The Cedar Shoot Borer, the Mahogany Moth.
becoming abundant in spring on *Cedrela odorata*, Doña Juana Camp, Villalba (349-40); in mahogany at Patillas (428-40).

Myelois ceratoniae Zeller (not *ceratonae*)
adults det. H. W. Capper from larvae in tamarind pods (I No. 7467), at Arecibo (I No. 6166).

Myelois decolor Zeller
reared from algarrobo pods at Arecibo (I No. 6074, 6088).

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Myelois notatilis Walker (= "*transitella* Walker" of authors) det. C. Heinrich
larvae completely destroying mamey seed at Mayaguez (I No. 6067).

Ephestia presumably *cautella* Walker—det. C. Heinrich
Fife 39-6: attacking injured cotton seed.
reared from icaco fruits at Bayamon (I No. 6611), from almendra fruits at Dorado (I No. 6576).

Etiella zinckenella Treitschke
Wolcott 35-144: more abundant in *Crotalaria incana* growing on sandy beaches than in heavy clay soil.
Wolcott 37-46 and 47: spraying with pyrethrum apparently inhibits oviposition on *Crotalaria incana*.
Wolcott 37-55 and 56: spraying with pyrethrum on lima beans apparently increased infestation.
Anon 37-43: a limiting factor in dry bean production (L. B. Scott).
Anon 37-74: larvae feeding on leaves of *Tephrosia toxicaria* (H. K. Plank).
Anon 38-71: heaviest infestation in pods of *Tephrosia* in summer (H. K. Plank).
Anon 39-108: parasitized by *Heterospilus etiellae* Rohwer at Isabela, and by *Argyrophylax* sp. nov.
Wolcott 38-84 to 88: "most common in lima beans and pigeon pea pods in spring and summer, but shows little seasonal variation in its original host, *Crotalaria incana* L." Partial control with cubé dust.
in pods of *Martinsia laurifolia* at Dorado (I No. 7206).

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Fundella cistipennis Dyar

Anon 37-43: a limiting factor in dry bean production (L. B. Scott).

Wolcott 37-56: abundant in lima beans in February (1936) at Isabela, none after beginning of April.

Wolcott 38-85: "its original wild hosts are the beach bean, *Canavali maritima* (Aubl.) Thou. and "hedionda," *Ditremexa* (*Cassia*) *occidentalis* (L.) Britton & Rose." Partial control by cubé dust.

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The data under the two species of *Elasmopalpus* should be reversed, and, with additions, should read as follows:

Elasmopalpus lignosellus Zeller

Möschler. Gundlach.

Dozier 26-117: notes. EEWI-194: a pest of sugar-cane.

Anon 37-43: attacking dry bean variety plantings at Las Mesas.

Anon 38-57: killed 90% of lima bean plants at Las Mesas, also peas and cowpeas.

larvae boring in stalks and stems of cowpeas (66-12 det. W. Schaus); larvae causing dead-hearts in ratoon shoots of young cane, trash burned, at Toa Baja (31-37).

Elasmopalpus rubedinellus Zeller

Möschler. Gundlach.

adults abundant, flying over land just plowed at Maunabo (541-12 det. W. Schaus).

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HYBLAEIDAE

Hyblaea puera Cramer

Martorell 39-25: an extensive outbreak in nurseries of capá blanco, *Petitia domingensis*, at Cayey. Control by spraying with arsenate of lead.

page 480

PTEROPHORIDAE

Adaina praeusta Möschler

at light (I No. 6891).

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TORTRICIDAE

Platynota rostrana Walker (not *Plationota*)

Anon 39-120: larvae on vanilla.

reared from icaco fruits (I No. 6579).

Episimus sp. nov.—det. Wm. T. M. Forbes

a leaf-folder or leaf-roller on maria, *Callophyllum antillanum*, at Vega Baja (168-40).

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Laspeyresia sp.—det. C. Heinrich

reared from almendra fruits at Arecibo (I No. 6355).

Crocidosema plebeiana Zeller

larvae in seed heads of *Sida cordifolia* at Vega Alta (I No. 6416, 6417, 6420); adults at light at Bayamon (I No. 6767), at Manati (I No. 6285).

Balbis excitana Möschler

Garcia-Diaz 38-96: listed.

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PHALONIIDAE

Phalonia sp. nov.—det. Wm. T. M. Forbes

Garcia-Diaz 38-96: listed

COSSIDAE

Psychonoctua personalis Grote

larvae very abundant in *Laguncularia racemosa* at Boca de Cangrejos (28-38) and of greater size than in coffee; adults at light, Mona Id. (165-39).

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YPONMEUTIDAE

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Plutella maculipennis Curtis

adults always present at light at Guajataca, regardless of season or weather (GNW).

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COSMOPTERYGIDAE

Pyroderces rileyi Walsingham

Fife 39-7: in partly decayed cotton bolls.

Batrachedra sp. nov.—det. Wm. T. M. Forbes

feeding in underside of young pineapple fruits at Corozal (161-40).

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GELECHIIDAE

? **Gnorimoschema** sp.—det. C. Heinrich

from pods of *Hecastophyllum ligulatum* at Dorado (I No. 6221).

Gnorimoschema gudmannella Walsingham

abundant on buds and in flowers of cultivated pepper and "ají," April 1940 (F. Sein).

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Dichomeris rusticus Walsingham—det. A. Busck

at light at Bayamon (I No. 6737).

Brachyacma palpigera Walsingham
Anon 37-74: adults det. A. Busck from larvae reared by H. K. Plank, feeding on *Tephrosia candida* and *T. toxicaria*.
Anon 38-71: abundant in pods during summer.
in pigeon pea pods (I No. 6893).

Anacampsis sp.—det. A. Busck
from hibiscus bolls at Vega Alta (I No. 6415).

page 490
Phthorimaea operculella Zeller
a serious outbreak on tobacco at Cayey in January (9-38).

page 492
Stegasta capitella F.
at light at Bayamon (I No. 6764).

Pectinophora gossypiella Saunders
Wolcott 35-143: disappearance of cotton as a commercial crop did not cause a disappearance of the pink bollworm, as maga pods served as alternate host.
Noble & Hunt 37-842: parasites of, reared for release in P. R.
Anon 38-101: two species of parasites released.
Pastor Rodriguez, J., "Nuestra Industria Algodonera se ve Amenazzda por un Insecto Peligrosos." El Imparcial Dominical, pp. 29-30, fig. 1. San Juan, May 23, 1937.
Fife, L. C., "Status of the Pink Bollworm in Puerto Rico during 1935-36." Jour. Agr. Univ. P. R., 21(**2**): 233-235. San Juan, (July) April 1937.
Fife, L. C., "Alternate Host Plants of the Pink Bollworm, *Pectinophora gossypiella* (Saund.) in Puerto Rico." Jour. Agr. Univ. P. R., **22**(4): 483-492, ref. 18. San Juan, (March 23, 1939) October 1938.
Fife 39-4: a summary; parasites of, introduced into P. R.
Cushman 40-362: host of *Calliephialtes ferrugineus* sp. nov. from Boquerón, P. R. (K. A. Bartlett).
Wolcott 40-29: in seed-pods of maga.
in out-of-season cotton at Isabela (83-37, 13-39); in cotton, Vieques Id. (100-40), on Mona Id. (73-39).

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OECOPHORIDAE

Ethmia notatella Walker
abundant at light, Mona Id. (213-39, 231-40).

Ethmia nivosella Walker
at light at Bayamon (I No. 6745).

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GRACILARIIDAE

Acrocercops dives Walsingham
larvae mining in leaves of *Inga vera* at Lares (46-36 det. A. Busck).

page 500

Leucoptera coffeella Guerin

Wolcott 35-144: *Chrysocharis lividus* Ashmead and four other new parasites reared by F. Sein.

Wolcott 37-48: ten parasites reared by F. Sein.

Wolcott 37-58 to 61: a summary of Mr. Sein's studies on parasitism of.

Wolcott 38-91: summary of Mr. Sein's work to date, the discovery of *Mirax insularis* Muesebeck in Guadeloupe, F. W. I., and that infestations are due to low humidity caused by rapid evaporation of moisture in localities not protected from the wind by soil contour.

Sein, F., "A Study of the Coffee Leaf-Miner, *Leucoptera coffeella* Guerin" and "Humidity a Factor in Leaf-Miner Infestations." *in* Ann. Rpt., Agr. Expt. Station, 1937-38, pp. 40-41. San Juan, 1939.

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PSYCHIDAE

Oiketicus kirbyi Guilding

larvae on leafless trees, Guanica Insular Forest (4-37); on casuarina at Arecibo (76-37); on almendra at Caguas (34-38); on roble at Aibonito (45-38); on capá blanco at San Sebastian (71-40); on morál at Cayey (120-40); on casuarina, Mona Id. (128-39).

Achanodes antipathetica Forbes

(as "sp.") Garcia-Diaz 38-96: listed.

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TINEIDAE

Tinea mimutella F.—det. A. Busck

reared by A. S. Mills from pupa on grapefruit at Bayamon (I No. 6770) "a most interesting, striking species, which has never been re-discovered since Fabricius' description. No specimen in British Museum, here, or in Cornell, before this." A. Busck.

Tineola uterella Walsingham

on walls of cabins, Mona Id. (233-40).

Homostinea tischeriella Walsingham

Garcia-Diaz 38-96: listed.

Mea includella Forbes

Garcia-Diaz 38-96: listed.

Protodarcia sp.

Garcia-Diaz 38-96: listed.

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MEGALOPYGIDAE

Megalopyge krugii Dewitz
adult resting almendra at Vega Alta (I No. 5948); larvae on almendra, cocoons on concrete posts, at Arecibo (57-38); larvae on *Andira inermis* at Cayey (92-40), on *Inga vera* at Cayey (112-40); cocoons on trunk of guácima tree at Ponce (340-40).

NEPTICULIDAE

Nepticula gossypii Forbes & Leonard
Fife 39-7: "only at Boquerón."

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HYMENOPTERA

Box, H. E., "The Introduction of Braconid Parasites of *Diatraea saccharalis* Fabr. into certain of the West Indian Islands." Bul. Ent. Research, **18**(4): 365-370, pl. 1, fig. 2. London, May 1928.

Dozier, H. L., "Descriptions of Miscellaneous Chalcidoid Parasites from Puerto Rico (Hymenoptera)." Jour. Agr. Univ. P. R., **21**(2): 121-135. San Juan, April 1937.

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TENTHREDINOIDEA

TENTHREDINIDAE

Sterictiphora zaddachi Dewitz = *Schizocera krugii* Cresson
Martorell 40-32: on moralón, *Coccolobis grandifolia.*
[Martorell, L. F., "Biological Notes on the Sea-Grape Sawfly, *Schizocera krugii* Cresson, in Puerto Rico." Caribbean Forester, **2**(3): 141-4, pl. 1. New Orleans, La., April 1941.]
"*Xylosericocera* is a MS name" (I No. 6205); on moralón near Lares (25-37); on cucubano, *Coccolobis laurifolia,* Maricao Insular Forest (-40); on sea grape at Camuy (46-37), at Guajataca (77-37, 42-39, 286-39), at San German (47-37), along the coast from Patillas to Maunabo (82-37), at Bayamon (I No. 6205), at Jayuda (I No. 5911), at Fajardo (1-40), at Salinas (4-40).

ICHNEUMONOIDEA

ALYSIDAE

Goniarcha sp. nov.—det. C. F. W. Muesebeck
in fruit fly traps at Mayaguez (I No. 6841, 6842, 7255, 7276).

Alysia analis Cresson
in cane field at Toa Baja (71-38).

BRACONIDAE

Opius (Utetes) anastrephae Viereck

Anon 38-96: reared by K. A. Bartlett at Mayaguez from both species of *Anastrepha:* "an important part in biological control; parasitism as high as 49.9% has been recorded."

Anon 39-99: "prevalent" in jobo fruit infested with *Anastrepha mombinpraeoptans* Sein.

reared from fruit fly larvae in jobo at Añasco (I No. 6405), at Arecibo (I No. 7340), at Caguas (I No. 6294), at Maunabo (I No. 7342).

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Opius sp. nov.—det. C. F. W. Muesebeck

from *Crocidosema plebeiana* Zeller at Dorado (I No. 6430).

Apanteles americanus Lepeltier

reared from sphinx caterpillar on papaya at Bayamon (I No. 5921), at Vega Alta (I No. 7184).

Apanteles disputabilis Ashmead—det. C. F. W. Muesebeck

adults abundant on flowers of *Malachra alceifolia* at Guayanilla (150-40).

Apanteles marginiventris Cresson

from cocoons on cane leaves (the host presumably *Laphygma frugiperda* caterpillars) at Salinas and Ponce (48-40 det. C. F. W. Muesebeck).

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Apanteles sp. nov.—det. C. F. W. Muesebeck

Anon 39-108: reared from *Lamprosema indicata* F. at Isabela.

Microbracon cushmani Muesebeck—det. C. F. W. Muesebeck

reared from *Mesocondyla concordalis* at Maunabo (50-40).

Microbracon hebetor Say

Fife 39-7: a parasite of *Ephestia cautella*

Microbracon kirkpatricki Wilk.—Introduced

Noble & Hunt 37-843: 40,000 released in P. R.

Anon 38-101: a parasite of the pink bollworm.

Fife 39-4: released at Camuy, October and November 1935.

Microbracon sp. nov.—det. C. F. W. Muesebeck

Anon 38-96: reared from *Anastrepha mombinpraeoptans* Sein at Mayaguez (K. A. Bartlett).

reared from *Acrocercops dives* Walsingham, a leaf-miner in *Inga vera,* at Lares (46-36); reared from *Crocidosema plebeiana* Zeller (I No. 6430).

Macrocentrus ancylivorus Rohwer—Introduced

Anon 39-108: not recovered at Isabela from lima bean podborers.

Macrocentrus sp.—det. C. F. W. Muesebeck
from *Anacampsis* sp. on hibiscus at Vega Alta (I No. 6431).

Chelonus annulipes Wesm.—Introduced
Anon 39-97: released as a parasite of *Diatraea saccharalis* F.

Chelonus blackburni Cam.—Introduced
Noble & Hunt 37-843: 14,000 released in P. R.
Anon 38-101: a parasite of the pink bollworm.
Fife 39-4: released at Isabela, Quebradillas, Camuy, Hatillo and Boquerón.

Exeristes roborator F.—Introduced
Noble & Hunt 37-843: 3,000 released in P. R.
Anon 38-101: a parasite of the pink bollworm.
Fife 39-4: released at Camuy, Isabela and Boquerón.

page 512
Phanerotoma planifrons Nees—Introduced
Anon 39-108: a parasite of the lima bean pod-borer, received from France, released in P. R.

Trigonophasmus sp. nov.—det. C. F. W. Muesebeck
on Mona Id. (285-40).

Ipobracon grenadensis Ashmead—Introduced
Box 28-365: introduced as a parasite of *Diatraea saccharalis* F. from British Guiana and Venezuela.

Ipobracon rimac Wolcott—Introduced
Dohanian 37-241: a parasite of *Diatraea saccharalis* F. in Peru.
Anon 38-96: released but not recovered in P. R.

page 513
Stantonia lamprosemae Muesebeck, C. F. W., "Two Reared North American Species of the Genus Stantonia Ashmead (Hymenoptera: Braconidae)." Proc. Wash. Ent. Soc., **40**(3): 89-91, fig. 1. Washington, March 1938: TYPE from Cuba, but a female was collected at Mayaguez, P. R., by H. L. Dozier on October 18, 1935.

Bassus stigmaterus Cresson—Introduced, but probably endemic
(as *Microdus diatraeae* Turner) Box 28-365: established in P. R. by introduction from British Guiana.
Dohanian 37-239: introduced from British Guiana.
the record (IB-513) of "*Bassus* (*Microdus*) *sacchari* Myers—det. C. F. W. Muesebeck, reared from larvae of *Diatraea saccharalis* F. on sugar-cane, October 1935 at *Hormigueros* (K. A. Bartlett)." is this species.
Anon 38-97: 4.8% of parasitism at Hormigueros in January 1936 (K. A. Bartlett).
Anon 39-97: reared at Añasco, released at Fajardo.
adult in field of young plant cane at Isabela (56-38 det. GNW).

Aphidius testaceipes Cresson

Wadley 37-106 to 107: a parasite of *Aphis maidis* and *Hysteroneura setariae.*

(as *Lysiphlebus*) Fife 39-9: a parasite of *Aphis gossypii.*

Mirax insularis Muesebeck, C. F. W., "A New West Indian Species of *Mirax* Haliday parasitic on the Coffee Leaf-Miner (Hymenoptera: Braconidae)." Proc. Ent. Soc. Washington, **39**(6): 139-140, fig. 1. Washington, June 1937: TYPE from Guadeloupe, French West Indies.—Introduced.

Sein 39-40: approximately 2,000 adults released in P. R., recoveries several generations later at Lares and Quebradillas, additional releases made in June 1938.

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ICHNEUMONIDAE

Calliephialtes ferrugineus Cushman, R. A., "New Genera and Species of Ichneumon Flies, with Taxonomic Notes." Proc. U. S. Nat. Mus., **88**(3083): 355-372. Washington, 1940: p. 362, TYPE from Boquerón, P. R., reared from *Pectinophora gossypiella* Saunders (K. A. Bartlett).

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Ephialtes rufoniger Cresson—det. R. A. Cushman

at Arecibo (I No. 6774).

Tromatobia lateralis Cresson (= *T. cressoni* Dewitz)

Cushman 40-363: "reared from spider egg-cocoon from Lares, P. R., September 8, 1921."

parasitizing spider egg-mass on cane leaf at Guanica (72-38).

page 517

Eiphosoma annulata Cresson

in cane fields at Salias (292-39), at Guayanilla (151-40); on flowers of *Borreria verticillata* at Aguadilla (260-39).

page 518

Stiboscopus thoracicus Ashmead

Wolcott 37-144: reported as a less common parasite of the coffee leaf-miner.

reared from *Apanteles* cocoons on tobacco hornworm (200-39 det. R. A. Cushman).

CYNIPOIDEA

FIGITIDAE

Eucoila (Hexamerocera) atriceps Ashmead & **E. (H.)** sp.

(as "sp.") Anon 38-96 & Anon 39-99: reared from *Anastrepha mombinpraeoptans* Sein and *A. suspensa* Loew at Mayaguez (K. A. Bartlett).

from fruit fly larvae in jobo fruits at San Sebastian (I No. 5991), at Caguas (I No. 6295); from larvae of *Euxesta stigmatias* Loew in rotten corn (I No. 7158).

CHALCIDOIDEA

AGAONIDAE

Colyostichus longicaudatus Mayr—det. A. B. Gahan
from figs at Arecibo (I No. 7450).

Idarnes carmae Walker—det. A. B. Gahan
abundant on *Ficus laevigata* and *F. stahlii* at Arecibo (I No. 6138, 6212, 7450).

Secundeisenia mexicana Ashmead—det. A. B. Gahan
on *Ficus stahlii* at Garrochales (I No. 7306); on *Ficus laevigata* at Arecibo (I No. 7450).

Blastophaga insularis Ashmead—det. A. B. Gahan
on *Ficus stahlii* at Arecibo (I No. 6138, 6212).

MYMARIDAE

Mymar antillanum Dozier 37-130: TYPE from Boquerón, P. R., others from Las Vegas, Mayaguez and Guanica.

Gónatocerus portoricensis Dozier 37-131: TYPE from P. R., swept from vegetation.

Gónatocerus antillensis Dozier 37-132: TYPE from Mayaguez, P. R.

Erythmelus longicornis Dozier 37-133: TYPE from Mayaguez, P. R.

Erythmelus miridiphagus Dozier 37-133: TYPE from Hormigueros, P. R.

Erythmelus nanus Dozier 37-134: TYPE from Mayaguez, P. R.

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TRICHOGRAMMIDAE

Xenufens ruskini Girault—det. A. B. Gahan
from eggs of *Prenes nero* at Canovanas (31-36).

Oligosita magnifica Dozier 37-135: TYPE from Cartagena Lagoon, P. R., others from Boquerón and Bayamon.

Trichogramma minutum Riley
Wolcott & Martorell 37-577 to 579: egg-clusters of *Diatraea saccharalis* F., both fresh and parasitized by *T. m.*, eaten by *Monomorium c. ebeninum* Forel.
Wolcott 38-98 to 101: initiation of observations on natural control by, of *Diatraea saccharalis* F.
Wolcott 39-38 to 40: experiments on release of laboratory-reared parasites in cane fields.

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TETRASTICHIDAE

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Tetrastichus haitiensis Gahan

Wolcott 35-144: abundance in spring.

Wolcott 37-53: "Deviation from a one year life-cycle is of tremendous importance to *Diaprepes abbreviatus* L. in enabling its eggs to escape attacks by this common parasitic wasp, which is most abundant during the late spring, but is very scarce during the autumn and winter."

Wolcott 37-90: changing the oviposition time of *Diaprepes abbreviatus* L.

Tetrastichus tatei Dozier 37-129: from *Gynaikothrips uzeli* on *Ficus nitida* at Mayaguez.

Tetrastichus marylandensis Girault

Wadley 37-106: a parasite of *Aphis maidis*.

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Tetrastichus sp. nov.—det. A. B. Gahan

Wolcott 35-144, Wolcott 37-59 and Wolcott 37-48: reared by F. Sein from leaf-miner infested coffee leaves.

in fruit of *Casearia decandra* at Vega Alta (I No. 6512).

ENTEDONTIDAE

Derastenus sp. near **fullawayi** Crawford

(as "sp.") Wolcott 35-144, Wolcott 37-48 and Wolcott 37-59; reared by F. Sein from coffee leaves infested with leaf-miner.

Closterocerus sp. near **cinctipennis** Ashmead

(as "sp.") Wolcott 35-144, Wolcott 37-48 and Wolcott 37-59: a less common parasite reared by F. Sein from coffee leaves infested with leaf-miner.

Closterocerus leucopus Ashmead

Wolcott 37-48 and Wolcott 37-59: Mr. Sein finds this the most abundant parasite of the coffee leaf-miner.

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Chrysocharis lividus Ashmead

Wolcott 35-144, Wolcott 37-48 and Wolcott 37-59: found by Mr. Sein to be the second most abundant parasite of the coffee leaf-miner.

Chrysocharis sp. det. A. B. Gahan

Anon 39-108: reared from *Lamprosema indicata* F. at Isabela.

Horismenus cupreus Ashmead

Wolcott 35-144, Wolcott 37-48 and Wolcott 37-59; third in order of abundance of parasites of coffee leaf-miner, as indicated by rearings conducted by Mr. Sein.

Horismenus sp.—det. C. F. W. Muesebeck
from *Apanteles americanus* Lep. at Vega Alta (I No. 7284).

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EULOPHIDAE

Dasyscapus parvipennis Gahan—Introduced
Dohanian, S. M., "Life History of the Thrips Parasite, *Dasyscapus parvipennis* Gahan, and the Technic for Breeding it." Jour. Ec. Ent., **30**(1): 78-80, ref. 6. Menasha, Wisconsin, February 1937.
Anon 38-99: Twelve generations reared in the laboratory and 26,000 released in P. R. but no permanent establishment noted.
Anon 39-108: not recovered.

SPALANGIDAE

Spalangia drosophilae Ashmean—det. A. B. Gahan
Bartlett 39-6: reared from horn fly puparium at Guanica Lake, September 22, 1936.

Spalangia haematobiae Ashmead—det. H. L. Dozier
Bartlett 39-6: recorded by Dozier

Spalangia muscidarum Richmond—det. A. B. Gahan
Bartlett 39-6: "parasitized as high as 30% of the puparia" of the horn fly in some collections.

Spalangia philippensis Fullaway—Introduced
Anon 38-100, Anon 39-99 and Bartlett 39-6: introduced as a horn fly parasite, recovered at Juana Diaz four months later from *Anastrepha acidusa*.

PTEROMALIDAE

Pachyneuron allograptae Ashmead
Fife 39-9: "the control of *Aphis gossypii* effected by *Baccha clavata* was to a large extent annulled by the action of a secondary pupal parasite."
from syrphid fly puparia, Mona Id. (214-40, 300-40 det. A. B. Gahan).

Pachyneuron siphonophorae Ashmead
Wadley 37-106 to 107: a parasite of *Aphis maidis* and *Hysteroneura setariae*.

Pachycrepoideus dubius Ashmead—det. C. F. W. Muesebeck
Bartlett 39-6: "reared in small numbers" from horn fly and/or house fly puparia.

Muscidifurax raptor Girault & Sandhouse—det. C. F. W. Muesebeck
Anon 39-107 and Bartlett 39-6: reared from horn fly and/or house fly puparia.

Neocatolaccus sp. nov.—det. A. B. Gahan
in puparium of *Baccha capitata* at San Sebastian (49-40).

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ELACHERTIDAE

Zagrammosoma seini Wolcott
(as "sp.") Wolcott 37-48 and Wolcott 37-59: a less common parasite of the coffee leaf-miner, as shown by the rearings made by Mr. Sein.

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Cirrospiloideus sp. nov.
Wolcott 37-48 and Wolcott 37-59: a less common parasite of the coffee leaf-miner.

Elachertus sp. nov.
Wolcott 35-144: reared from coffee leaves infested with coffee leaf-miner.

ELASMIDAE

Elasmus platyedrae Ferriére—Introduced
Noble & Hunt 37-843: 57,000 of this parasite of the pink bollworm released in P. R.

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APHELINIDAE

Encarsia nigricephala Dozier 37-129: TYPE, three females from whitefly, *Bemisia* sp., on *Euphorbia hypericifolia* at Mayaguez, P. R.

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Prospaltella berlesei Howard—Introduced
Anon 38-98: from Louisiana, released for control of scales on papaya.

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delete EUCALYMNATUS

ENCYRTIDAE

Aphycus sp. nov.—det. A. B. Gahan
(I No. 6290, 6585).

Metaphycus monticolens Dozier 37-124: TYPE from Maricao, P. R., another from Mayaguez.

Leptomastidea antillicola Dozier 37-121: TYPE, a single male from *Pseudococcus virgatus* on *Inga vera* at San Sebastian, P. R.

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Anagyrus similis Dozier 37-122: TYPE swept from grass at Santa Isabel, P. R., others from San German and Guanica.

Anagyrus graminicolens Dozier 37-123: TYPE swept from grass at Mani beach (Mayaguez), P. R.

Anagyrus coccidivorus Dozier—Introduced
Anon 38-98, Anon 38-107 and Bartlett 39-67 to 71: described from Haiti, introduced as a parasite of the pineapple mealybug from Hawaii, released in P. R. but not recovered.

Hambletonia pseudococcina Compere—Introduced
Anon 38-98, Anon 39-107 and Bartlett 39-67 to 71: from Brasil and Venezuela, introduced as a parasite of the pineapple mealybug from Hawaii, released in P. R. and recovered at Lajas.

Oöencyrtus sp. nov.—det. A. B. Gahan
Bartlett 39-497: a hyperparasite on *Gonatopus* sp.

Oöencyrtus sp. nov.—det. A. B. Gahan
from eggs of *Prenes* sp. at Guanica (16-38, 17-38), at Guajataca (65-38).

Aphidencyrtus aphidivorus Mayr
Wadley 37-107: a parasite of *Hysteroneura setariae.*

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Homalopoda cristata Howard
Dozier 37-123: at Guayama and Mayaguez.

Pseudohomalopoda prima Girault
Dozier 37-124: reared from scales on lemon at Mayaguez.

Cheiloneurus pulvinariae Dozier
(as "sp.") Anon 39-100: reared from *Asterolecanium bambusae* by K. A. Bartlett.

Hunterellus hookeri Howard
Dozier 37-125: from *Rhipicephalus sanguineus,* the brown dog tick, at Mayaguez.

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CALLIMOMIDAE, and transfer the following record to page 518, under AGAONIDAE

Colyostichus (not *Colostichus*) *biannulatus* Mayr—det. C. F. W. Muesebeck
infesting fruits of *Piper* at Cidra (I No. 1631 Leonard 33-131).

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EURYTOMIDAE

Bephrata cubensis Ashmead
reared from fruit of *Annona reticulata* at Yauco (6-37).

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EUCHARIDAE

Kalapa furcata F.—det. A. B. Gahan
resting on guava leaf at San Sebastian (51-38).

CHALCIDIDAE

Brachymeria incerta Cresson
Fife 39-6: parasitizing *Alabama argillacea.*
in cane field at Salinas (256-39); reared from chrysalis of *Pieris monuste* at Guanica (30-37); from pupa of *Psara bipunctalis* at Guanica (267-39); from pupa of *Mesocondyla concordalis* at Maunabo (51-40); at Cayey (226-39); on Mona Id. (268-40.)

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Brachymeria robustella Wolcott
resting on grapefruit at Pueblo Viejo (I No. 6773).

Spilochalcis flavopicta Cresson—det. A. B. Gahan
Fife 39-7: a parasite of *Pyroderces rileyi.*
on Mona Id. (178-39 "very near or possibly only a variant").

Spilochalcis femorata F.
at Vega Baja (I No. 7300), at Guanica (326-39).

Spilochalcis homaledrae Wolcott
on blossoms of *Pisonia albida,* Mona Id. (308-40 det. A. B. Gahan).

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Spilochalcis cocois Wolcott
in fruit fly trap (I No. 6921, 6925, 6895 as "near *cocois* Wolcott"), at Bayamon (I No. 6872).
The record "on corn at Isabela (107-31)" should be under *S. femorata* F., re-determined GNW.

Smiera eubule Cresson
at Salinas (259-39); reared from chrysalis of *Phoebis* (*Callidryas* or *Aphrissa*) *statira neleis* Boisduval on *Melicocca bijuga* (322-39).

Trigonura sp. nov.—det. A. B. Gahan
many adults on logs of *Inga vera* at la Yndiera (Lares-Yauco road) apparently attempting to parasitize Cerambycid eggs or larvae, *Neoclytus araeniformis* Olivier, under bark (320-21).

PROCTOTRUPOIDEA

DIAPRIIDAE

Ashmeadopria sp. nov.—det. C. F. W. Muesebeck
Bartlett 39-6: "a parasitism of 10%" of hornfly puparia.
Anon 38-96 and Anon 39-90: reared from *Anastrepha mombinpraeoptans* Sein.

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SCELIONIDAE

Prophanurus alecto Crawford
Wolcott, G. N., "*Prophanurus alecto* Crawford in Puerto Rico." Jour. Ec. Ent., **31**(1): 152-153. Menasha, Wisconsin, February 1939.
reared from eggs of *Diatraea saccharalis* F, at Quebradillas, Isabela and Coloso (64-38 det. C. F. W. Muesebeck), at Guanica (75-38).

Telenomus sp. near **convergens** Ashmead
Wolcott 37-48 and Wolcott 37-59: a less common parasite of the coffee leaf-miner, as indicated by the rearings by Mr. Sein.

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FORMICOIDEA

Smith, M. R., "The Ants of Puerto Rico." Jour. Agr. Univ. P. R., **20**(4): 819-875, fig. 19, ref. 16. San Juan (January 1937) October 1936: keys and notes on all ants found in P. R.; only new species or subspecies, and new records are noted below.

PONERINAE

Platythyrea punctata F. Smith
in termite nest at Ciales (613-22).

Ponera opaciceps var. **jamaicensis** Aguayo
Smith 36-826: at Ensenada and in the mountains north of Yauco.

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Ponera trigona var. **opacior** Forel
Smith 36-826: in the mountains east of Mayaguez.

Odontomachus haematodes L.
in nest of termite, *Nasutitermes costalis,* at Ciales (467-21); in rotten stump, Mona Id. (131-39 det. M. R. Smith as "var.").

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MYRMICINAE

Pseudomyrma flavidula delicatula Forel
at Bayamon (99-24 det. M. R. Smith), at Manati (I No. 5989).

Monomorium carbonarium ebeninum Forel
Wolcott, G. N. & Martorell, L. F., "The Ant, *Monomorium carbonarium ebeninum* Forel, in a new Rôle, as Predator on the Egg-Clusters of *Diatraea saccharalis* F., in Puerto Rican Cane Fields." Jour. Agr. Univ. P. R., **21**(4): 577-579. San Juan (November 12) October 1937: attacking about one-sixth of 9,000 egg-clusters examined.

Wolcott 38-95: occupying hormiguilla tunnels in guamá tree at Mayaguez, deserted by hormiguilla after fight with hormiga brava over thallium poison bait.

feeding on eggs of *Diatraea saccharalis* (22-36 det. M. R. Smith).

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Monomorium floricola Jerdon

nesting in stump, Mona Id. (181-39 det. M. R. Smith).

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Solenopsis geminata F.

Wolcott 37-42: defeated by hormiguilla in raids on poison meat bait on mango tree at Rio Piedras.

Wolcott 38-95: so weakened colony of hormiguilla in raids on thallium meat bait in guamá tree at Mayaguez that galleries were later occupied by *Monomorium c. ebeninum* Forel.

Fife 39-4: predacious on pink bollworm.

attending *Saissetia oleae* on capá prieto at Salinas (9-40); on grapefruit at Dorado (I No. 6409); attending scales on teak at Patillas (426-40); on Mona Id. (210-39), attending cottony cushion scale on casuarinas (312-40 det. M. R. Smith).

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Crematogaster steinheili Forel (not *Cremastogaster*)

on lignum-vitae tree, attending *Crypticerya rosae,* at Guanica (48-37 confirmed M. R. Smith).

Pheidole subarmata Mayr var. **borinquenensis** Wheeler (not *borinquensis*)

Pheidole fallax jelskii antillensis Forel

Anon 38-103: "harbors the intermediate or cystic stage of the tapeworms of the *Raillietina* group in the chicken (det. M. R. Smith)."

Macromischa isabellae Wheeler subsp. nov. *mutica* Smith 36-847: TYPE from Maricao Insular Forest, P. R.

Rogeria curvipubens Emery

Smith 36-851: at Ensenada.

Tetramorium lucayanum Wheeler

Smith 36-852: at Mayaguez.

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Wasmannia auropunctata Roger

on grapefruit tree (I No. 7328); on Mona Id. (183-39 det. M. R. Smith).

Sturmigenys eggersi Emery

Smith, 36-855: at Juana Diaz and Maricao Insular Forest.

Epitritus emmae Emery

Smith 36-858: at Arecibo and Ensenada.

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DOLICHODERINAE

Tapinoma melanocephalum F.
Wolcott 38-96: only temporarily interested in fresh meat thallium mixture.

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Dorymyrmex pyramicus niger Pergande
nesting in stump, Mona Id. (182-39 det. M. R. Smith) and attending cottony cushion scale on casuarinas (312-40 det. M. R. Smith).

FORMICINAE (not CAMPONOTIDAE)

Prenolepis (Nylanderia) microps M. R. Smith 36-868: TYPE from 14 Km. east of Mayaguez, P. R.

Prenolepis longicornis Latreille
Wolcott 39-96: individuals killed by fresh meat thallium bait, but the colony persists.
in house at Arecibo (I No. 7236); on Mona Id. (209-39).

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Myrmelachista ramulorum Wheeler
Wolcott 37-41 to 44: experiments in control by meat or fish mixed with thallium nitrate or thallium acetate.
Wolcott 37-61: fish oil repellant; continued experiments show no improvement in poison bait itself is needed, but in method of application, as water-soluble thallium compounds are very toxic to coffee shade trees.
Wolcott 38-93: collapsible metal foil tubes in which to apply poison bait only moderately successful.
Wolcott 39-41 to 43: unexplained failure of attractiveness of thallium bait.

Myrmelachista ramulorum subsb. nov. **fortior** Wheeler, Wm. M., "Neotropical Ants collected by Dr. Elizabeth Skwarra, and Others." Bull. Bussey Comp. Zoology, Harvard, **77**(5): 157-240, fig. 6. Cambridge, 1934: p. 189, TYPE from Mona Id., others from P. R.
Smith 36-873: quoting Wheeler.

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Camponotus ustus Forel
under bark of *Sideroxylon foetidissimum* at Ciales (418-40).

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SPHECOIDEA

BEMBECIDAE

Bicyrtes spinosa F.—det. G. A. Sandhouse
on Mona Id. (143-39).

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Stictia signata L.

on Mona Id. (127-39).

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SPHECIDAE (LARRIDAE)

Sceliphron caementarium Drury

Anon 38-102: on corn.

building nests of mud, provisioned with spiders, at Bayamon (I No. 6006), on underside of nearly horizontal coconut palm at Manati (155-40), in concavities of big rock at Aibonito (189-40); resting on guava bush at Villalba (98-37).

Notogonidea ignipennis Smith

at Bayamon (I No. 6033, 6036, 6039); in cane fields at Coloso (26-39); on fresas, Peñon del Collao, Cayey (121-40); on flowers of *Borreria verticillata* at Aguadilla (26-38); abundant on flowers of *Heliotropum indicum*, Vieques Id. (106-40).

Notogonidea trifasciata Smith

in fruit fly trap (I No. 6819 as "*Leptolarra*").

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Larra americana Saussure—Introduced

Wolcott 37-63: first attempt at introduction into P. R.

Wolcott 38-96 to 98: difficulties encountered in introduction.

Wolcott, G. N., "The Introduction into Puerto Rico of *Larra americana* Saussure, a specific Parasite of the "Changa," or Puerto Rican Mole-Cricket, *Scapteriscus vicinus* Scudder." Jour. Agr. Univ. U. R., **22**(2): 193-218, fig. 4, ref. 16. San Juan, (May) April 1938.

Wolcott, G. N. (translated by F. Sein), "Importando avispas del Brasil para acabar con las changas puertorriqueñas." El Mundo, p. 7, fig. 3. San Juan, October 30, 1938.

Wolcott, G. N., "Presence of Host Keeps Parasites alive in Captivity." Science, **87**(2259): 352. New York, April 15, 1938.

Wolcott 39-43: successful bulk shipments when accompanied by live parasitized hosts.

Gage 39-21: "In May 1938 it was demonstrated that these parasites can be brought alive to Puerto Rico."

Wolcott 39-508 and 509: successful establishment at Rio Piedras and at Isabela, P. R.

[Wolcott, G. N., "The Establishment in Puerto Rico of *Larra americana* Saussure." Jour. Ec. Ent., **34**(1): 53-6, ref. 8. Menasha, Wis., April 23, 1941.]

on flowers of *Hyptis atrorubens* at Paramaribo, Dutch Guiana (10-36); on flowers of *Borreria verticillata* at Caripito, Venezuela (L. F. Martorell—det. G. A. Sandhouse "all males"); on flowers of *Borerria verticillata* at Malezas

Farm, Isabela, seven months after the last release, in January (4-39), abundant in February (22-39), not so abundant in April (46-39), nor in July (49-39), none until November (307-39), in December (369-39), in January, March and April (14-40), sixty females collected at Punta Borinquen U. S. Army Air Base No. 1, nearly one-half mile east (against the wind) of point of original release at Malezas Farm, on bare ground with numerous changa tunnels, May 8, 1940, released one hour later at Isabela Sub-Station (167-40), dispersion one mile east to San Antonio and one-half mile west to cliff overlooking ocean, by end of June (195-40); on flowers of *Hyptis atrorubens,* Laguna San José, near Rio Piedras (5-39) in January, in November (337-39), in December 368-39); on flowers of *Borreria verticillata,* between Vega Baja and Camp Padilla, Laguna Tortuguero, nine months after release, in March (135-40) and in April, May and June.

Tachytes insularis Cresson

Dewitz. Gundlach, "rara."

"From a study of the specimens of this genus from Porto Rico, it appears that a single species is involved, and according to the material in the collection, the name should be *insularis* Cr., rather than *argentipes* Sm. However, the types would have to be seen to verify this." G. A. Sandhouse.

(as *T. argentipes* Smith—det. S. A. Rohwer) IB-559: many records.

at Barceloneta (I No. 6779); resting on guava bushes Sabana Grande (86-37); frequenting flowers of *Borreria verticillata* at Aguadilla (27-38); on flowers of *Heliotropum indicum,* Vieques Id. (105-40); at the airport, Mona Id. (141-39, 275-40).

Prionyx thomae F.

at the airport, Mona Id. (138-39) and abundant on the plateau (259-40); in cane field at Naguabo (2-40), at Santa Isabel (20-39 det. G. A. Sandhouse); dead adult in salt lagoon at Guanica (85-37), frequenting flowers of everlasting at Fajardo (60-38).

Tachysphex sp.—det. G. A. Sandhouse

(I No. 6780).

Ammobia ichneumonea L. var. **auriflua** Perty

in cane field at Arecibo (23-39); in Maricao Insular Forest, elev. 2,600 ft. (265-39), elev. 3,000 ft. (357-39).

Chlorion (Ammobia) singularis F. Smith

= *Chlorion* (*Ammobia*) *dubitatum* (Cress). "From a study of specimens from various localities, it is evident that these are conspecific, but the synonymy has not been published." G. A. Sandhouse.

(as *Chlorion dubitatum*) Van. Z. (P. R. 93).
(as *Ammobia dubitata*) AMC: at many localities.
(803-14 re-determined G. A. Sandhouse); with *Conocephalus fasciatum* DeG. in her burrow (675-12 re-determined G. A. Sandhouse); at Bayamon (I No. 6035); frequenting flowers of *Borreria verticillata* at Yabucoa (61-39 det. G. A. Sandhouse, 357-39); at Guanica (I No. 1656 Leonard 33-131), at Salinas (I No. 4648); on Mona Id. 274-40); on flowers of *Hyptis atrorubens* (350-39).

VESPOIDEA

BETHYLIDAE

Goniozus playtynotae Ashmead—det. C. F. W. Muesebeck
reared from larvae of *Agathodes designalis* Guenée, at Cayey (93-40).

Perisierola sp. nov. "near *nigrifemur* Ashmead"—det. C. F. W. Muesebeck
Anon 38-101: a parasite of the pink bollworm.
Fife 39-4: a native parasite of the pink bollworm.

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Gonatopus sp. nov.—det. C. F. W. Muesebeck
Bartlett, K. A., "A Dryinid Parasite attacking *Baldulus maidis* in Puerto Rico. Jour. Agr. Univ. P. R., **22**(4): 497. San Juan, (March 23, 1939) October 1938.

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SCOLIIDAE

Elis haemorrhoidalis F.
Jepson 36-5 and 20 to 22: "parasitic on *Phytalus apicalis* Blanchard"; observations on, in P.R.
females in cane field at Aguadilla (25-38); feeding on excrement from green scale on *Rauwolfia tetraphylla* at Aguadilla (3-38); frequenting flowers of *Bucida buceras*, Vieques Id. (102-40); frequenting flowers of *Borreria verticillata* at Aguadilla (25-38, 253-39, 15-40) at Yabucoa 59-39, 240-39); on flowers of *Colubrina colubrina* and *Pisonia albida*, Mona Id. (216-40).

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Elis ephippum F.
(as *Elis xanthonotus* Rohwer) Jepson 36-5, 18 to 25, 26: "reared on second stage grubs of the larger *Lachnosterna*"; observations on, collections and shipment to Mauritius; summary.
females frequenting flowers of *Hyptis atrorubens* (4-38, 364-39) confirming observations of E. G. Smyth, but, contrary to his observations, also on flowers of *Borreria verti-*

cillata (= *Mitracarpus portoricensis*) at Manati (338-39), at Yabucoa (60-39, 28-40), at Aibonito (191-40).

Myzine nitida Smith
(as "sp.") in fruit fly trap at Mayaguez (I No. 6863).

Tiphia argentipes Cresson
Jepson 36-5: not found.

Tiphia sp.
very small males, apparently differing from *T. hispaniolae* Wolcott, TYPE from Haiti, only in size: at light (67-40), on guava at San Sebastian (69-38), at Coloso (325-39); very small female on the beach at Mayaguez (43-39).

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Campsomeris atrata F.
female in cane field, Central Fortuna, Ponce (2-39); dead on the beach, Mona Id. (111-39), and frequenting flowers of *Moringa moringa, Pisonia albida* and *Colubrina colubrina,* Mona Id. (205-40) much more abundant than on the island of Puerto Rico.

Campsomeris dorsata F.
Jepson 36-5, 19 to 25, 28: "Long known as a common parasite of *Ligyrus tumulosus* Burm. in Puerto Rico"; observations on, collections and shipments to Mauritius; summary.
Jepson, W. F., "A Summary of the Results of the *Phytalus* Investigation 1933-36." pp. 19. Port-Louis, Mauritius, 1936: eighteen females survived the trip from P. R. to Mauritius, 53 days en route, were released in Mauritius, but with no recovery to date.
Wolcott 37-80: quoting Mrs. Dexter: 5.1% of the food of *Bufo marinus* L.
Anon 39-75: visiting sweet potato flowers.
females on flowers of *Borreria verticillata* at Vega Baja (61-40), of *Kallstroemia maxima* at Yauco (36-37), of malva, *Malachra alceifolia,* at Guayanilla (80-40), of aveyuelo and *Moringa moringa,* Mona Id. (217-40); males, on Mona Id. (139-39), on flowers of *Borreria verticillata* at Yabucoa (58-39).

Campsomeris trifasciata F.
Jepson 36-5, 18 to 25, 28: "normally a parasite of *L. portoricensis,*" observations on, summary.
(I No. 7137), both sexes abundant on flowers of *Waltheria americana* at Aguadilla (16-40), of *Hyptis atrorubens* (365-39), of *Melanthera confusa* at Manati (136-40), of *Borreria verticillata* at Yabucoa (57-39, 244-39), at Manati (114-39).

Campsomeris tricincta F.
Jepson 36-5, 20, 29: mention, collected at Cidra, summary.

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PSAMMOCHARIDAE

Pepsis rubra Drury

(I No. 6907), at Bayamon (I No. 6032); at Pt. Cangrejos (396-22 det. N. Banks) frequenting flowers of *Borreria verticillata,* at Aguadilla (52-38); at Mayaguez (I No. 7381), at Naguabo (231-39).

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Pepsis ruficornis F.

at Coloso (25-39) at sea-level; in Maricao Insular Forest, elev. 2,600 ft. (264-39).

Notiochares cubensis Cresson (= *Pompiloides propinquus* Fox) det. N. Banks

carrying legless spider at Coloso (73-38); frequenting flowers of *Heliotropum indicum,* Viequez Id. (107-40).

Cryptocheilus flammipennis Smith

at Bayamon (I No. 6037).

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VESPIDAE

Polistes crinitus Felton

Anon 38-101: attacking *Laphygma frugiperda* caterpillars on corn (W. K. Bailey).

at Guaynabo (I No. 7138 as "var. *americanus* F." det. G. A. Sandhouse); in fruit fly traps at Bayamon (I No. 7073); enormous numbers on El Yunque rock (45-39) with no other wasp present; on Mona Id. (135-39, 247-40); on tender foliage of *Coccolobis laurifolia,* Mona Id. (41-40); frequenting flowers of *Heliotropum indicum,* Vieques Id. (108-40); at Aibonito (188-40).

presumably the record of "*Polistes canadensis* L., Wetmore 16-77; eaten by Kingbird." should come here.

Polistes major P. B.

Bequaert, J. C., "Two New Color Forms of *Polistes major* Palisot de Beauvois from California and Arizona." Ent. News, **47**(1): 7-13. Philadelphia, 1936: the first record from P. R., collected by F. Sein at Lares; presumably blown in by the hurricane of 1928.

Anon 38-101: attacking caterpillars of *Laphygma frugiperda* on corn (W. K. Bailey).

at Lares (100-31 det. J. C. Bequaert); in fruit fly trap at Vega Alta (I No. 7259); frequenting flowers of *Borreria verticillata* at Palo Seco (361-39, 55-40), at Aguadilla (47-39); resting on sugar-cane at Aguadilla (281-39); nesting on sea-grape and casuarina trees, Mona Id. (137-39 det. G. A. Sandhouse).

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Mischocyttarus cubensis Saussure

Anon 38-102: attacking caterpillars of *Laphygma frugiperda* on corn (W. K. Bailey).

on Mona Id. (136-39); attached to citrus leaves by an entomogenous fungus (385-39 F. Mora) at Lares.

EUMENIDAE

Zethus rufinodus Latreille

at Bayamon (I No. 6034); on flowers at Lares (154-40); on flowers of *Hyptis atrorubens* (6-39); on flowers of *Lantana camara,* Mona Id. (140-39); on tender foliage of *Coccolobis laurifolia,* Mona Id. (42-40); nesting in rotten fence-posts of almacigo and other woods, Laguna Tortuguero (494-40).

Eumenes ornatus Saussure

(as "var. *abdominalis* Drury") at Loiza (I No. 6906); in fruit fly trap at Palo Seco (I No. 6922 as "var. *ornatus* Saussure").

Pachodyneurus (Monobiella) atratus F.

in mud-wasp nest, of *Sceliphron caementarium* Drury ?, on rock cliff near Utuado (30-38); frequenting flowers of *Borreria verticillata* at Yabucoa (317-39), at Cayey and Isabela (18-40), of *Hyptis atrorubens* (349-39).

Pachodyneurus nasidens Laterille

frequenting flowers of *Hyptis atrorubens* (60-40), of *Borreria verticillata* at Yabucoa (238-39 det. G. A. Sandhouse).

Pachodyneurus tibialis Saussure

frequenting flowers of *Lanatana camara,* Mona Id. (144-39 det. G. A. Sandhouse), of *Colubrina colubrina* (273-40).

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Ancistrocerus dejectus Cresson

in fruit fly trap at Mayaguez (I No. 6860 as "sp.").

APOIDEA

HALICTIDAE

Agapostemon portoricensis Cockerell (not a variety of *radiatus*)

at Bayamon (I No. 6041), at Dorado (I No. 6904); in flight, Salinas-Cayey road (228-39 det. G. A. Sandhouse); on flowers of *Lantana camara,* Mona Id. (149-39 det. G. A. Sandhouse).

Augochlora buscki Cockerell—det. G. A. Sandhouse

at Bayamon (I No. 6040), at Dorado (I No. 6905).

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ANTHOPHORIDAE

Centris haemorrhoidalis F.
nesting in clay bank at Guajataca (279-39); frequenting flowers of *Borreria verticillata* at Aguadilla (138-40, of *Moringa moringa* and *Pisonia albida,* Mona Id. (210-40).

Centris lanipes F.
on Mona Id. (150-39 det. G. A. Sandhouse), on flowers of *Moringa moringa* (208-40).

Centris versicolor F.
on the beach at Mayaguez (I No. 7417 as "*C. decolorata* Lep."), on the beach at Humacao (115-39, females 233-39, males 232-39 det. G. A. Sandhouse); frequenting flowers of *Lantana camara,* Mona Id. (117-39 det. G. A. Sandhouse), of *Moringa moringa,* Mona Id. (209-40).

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Exomalopsis globosa F.
frequenting flowers of *Hyptis atrorubens* (367-39) and of *Borreria verticillata* (139-40) at Guajataca Dam.

Anthophora krugii Cresson
nesting in clay bank of roadside at Guajataca (278-39); in walls of cave, Mona Id. (81-39); frequenting flowers of *Moringa moringa* and *Colubrina colubrina,* Mona Id. (211-40).

EUCERIDAE

Mellisodes trifasciata Cresson
Anon 39-75: visiting sweet potato flowers.
at Palo Seco (I No. 6776); frequenting flowers of anamú, *Petiveria alliacea,* at Guayanilla (24-37).

MEGACHILIDAE

Hypochrotaenia (Pasites) pilipes Cresson
on flowers of pepper at Guaynabo (I No. 6775).

Coelioxys abdominalis Guerin
in cane field at Guajataca (27-39).

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Megachile lanata F. (= *M. martindalei* Fox)
Anon 39-75: visiting sweet potato flowers.
at Barceloneta (I No. 6778).

Megachile vitrasi Pérez
at Loiza (I No. 6777); frequenting flowers of *Borreria verticillata* at Yabucoa (237-39); resting on cane leaf at Guanica (225-39); on Mona Id. (142-39 det. G. A. Sandhouse) on flowers of *Moringa moringa* and *Pisonia albida* (246-40).

XYLOCOPIDAE

Xylocopa brasilianorum L.

frequenting sunflowers at Vega Alta (I No. 7217); abundant on Mona Id. (120-39).

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APIDAE

Apis mellifera L.

Wolcott 37-49: Mr. Sein's experiments indicating that neither bees nor other insects are necessary for the setting of the coffee crop.

nest in rocks near Guanica lighthouse (3-37), in hollow mamey tree, Sabana Llana (GNW); adults almost the only large Hymenopteron present on *Hyptis atrorubens* near Mountain Top Nursery, Patillas (11-39); adults on flowers of guamá, Cayey (123-40), of malva, *Malachra alceifolia*. at Guayanilla (83-40).

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LIFE HISTORY NOTES ON SOME WEST INDIAN COENAGRIONINE DRAGONFLIES (ODONATA)

By James G. Needham

In the following pages I wish to bring together some scattered notes and observations on the life histories of a number of West Indian damselflies observed during five recent visits to the West Indies.

In 1930, while on an airplane trip to Paramaribo and back, I did a little collecting at the stops made in Cuba, Hayti, Puerto Rico, Trinidad, and British Guiana. Most of the nymphal material obtained on this trip was turned over to Dr. Elsie Broughton Klots, and was used by her in the preparation of her fine paper on the Odonata of Puerto Rico, but there were questions left open concerning certain of the nymphs of Coenagrioninae.

In 1935 I spent the months of February and March in Puerto Rico collecting jointly with Dr. Julio García-Díaz in all the principal streams of the Island. The Odonate material thus obtained, in the collecting of which Dr. García fully shared, was used by him in his excellent paper; "An Ecological Survey of the Fresh Water Insects of Puerto Rico: I. Odonata," published in the Journal of Agriculture of the University of Puerto Rico, 22: 43–97, 1938. Still there remained unknown the nymphs of several genera.

In 1937, on the kind invitation of Dr. Thomas Barbour, I spent the month of April at the Atkins Institution of Harvard University, Soledad, near Cienfuegos, Cuba, collecting and rearing dragonflies. In that work I was greatly aided by two members of the staff of the Botanical Garden; Mr. Walsingham and Mr. Parsons. The results there obtained were incorporated in part in my paper with Dr. Elizabeth Fisher on The Nymphs of Libellulinae that was published in *Trans. Amer. Entom. Soc.*, 62: 107–116, 1 pl., 1936. In part they will be used in the following pages to fill several gaps that still remained.

In 1939 I went again to Cuba, accompanying Dr. J. C. Bradley. We went by automobile, first to Soledad. While there we were taken by the director of the Garden, Mr. David Sturrock, on a very delightful and profitable trip eastward into the Trinity Mountains, where we found good collecting.

We then went to the Agricultural Experiment Station at Santiago de las Vegas, where we joined four members of the Station staff in a collecting trip to the western province of Piñar del Rio. Dr. C. S. Bruner, Chief entomologist of the Station, Dr. J. Acuña, Mr. L. de Zayas and Mr. Leon Bouclé were the ones who went with us, lending us great aid by their knowledge of the country and assisting us in many other ways. Dr. Acuña proved adept at catching adult dragonflies. On the results of that trip I have as yet published only one small paper; a life history of *Neoneura carnatica* (*Entom. News*, **50**: 241–245).

In 1940 I spent a second semester (February to May inclusive) teaching in the University of Puerto Rico, and while there I devoted much of my spare time to further rearing and study of Coenagrionine dragonflies. Then I went with Dr. and Mrs. Julio García-Díaz to Santo Domingo for the month of June. We were continuously in the field, collecting and rearing Odonata. We went by automobile, all over the Republic, guided and aided by good friends who live there, and the result was a real harvest of new material. The following pages will present an account of some of it.

The life histories and habits of the West Indian species of four genera are to be dealt with in the following pages: *Hypolestes, Lestes, Enallagma,* and *Leptobasis*. Nymphs of the genera *Protoneura* and *Microneura* even yet have not been found.

HYPOLESTES

To find nymphs of this genus was one of my chief purposes in going to Santo Domingo. Arrived in Barahona, I was very fortunate in obtaining the aid of Mr. George Hamor, and under his guidance Dr. García-Díaz and I were taken into what appeared to be the very headquarters of *Hypolestes*.

The place was Palomino cañon; a steep-walled rocky cleft in the northeast foothills of the Barahuco mountain range. At the head of this cañon is the spring-fed source of the water that the city of Barahona uses for drinking purposes. It is about 15 miles out of Barahona; some two miles northward over the good main highway, and then perhaps 13

miles generally westward over a rocky road, just passable by automobile, up the cañon.

The Palomino river in its course runs around a great flat topped hill, and then across an outwash plain to join the Rio Yaque del Sur. The first part of our rough road up it lay among the outwash cobblestones in the dry stream bed. Then the road mounted the side of the big hill roller-coaster fashion, crossed the upland level, and then descended again toward a living stream of water that here went rushing downward through a narrow rocky gulch. Leaving the car on the down slope of the hill, a short walk brought us to the water supply intake. Here the crystal stream was heavily shaded with trees and vines, and the air was cool and humid, and here we collected *Hypolestes:* adults in numbers and easily, and nymphs, a few, by dint of much searching among the rocks in the swift waters.

The first dragonfly that I saw here was a *Hypolestes*. It was sitting calmly on a trailing vine at my feet with wings *quite horizontally outspread*. I stood stock still, and with extreme care planned the stroke that landed the specimen in my net. Such caution proved to be wholly unnecessary, for it made no effort to elude me. Soon we were finding others, and taking them with ease. Every few steps along that shaded streamside pathway, another one would rise and flutter slowly away and quickly settle again.

The adult *Hypolestes* is easy to catch; the easiest of all the Odonata that I have ever taken. It sits quietly in the shade with wings outspread, and when flushed from one restingplace it flies quickly to another near by; and instead of seeking the shelter of denser vegetation, it perches again, apparently by preference, on the most exposed leaf or spray, and again stupidly awaits approach. No strategy at all is needed for securing specimens. Indeed, I found that by approaching very slowly and cautiously I could catch specimens with my fingers. After using a net long enough to insure a good lot of specimens, I caught a number more of them bare handed.

It was not so easy to collect nymphs. After an hour or more of fruitless searching among the big rocks in the swiftest water I finally found one nymph among smaller stones in a riffle that was overspread with leaf drift. Then I settled down to explore this riffle: I placer-mined it, so to speak. I held a screen in the outwash, and stirred the stones above it, picking the nymphs from the material carried by the water on to the screen. Mr. Hamor assisted me with this, and we

together obtained ten nymphs. They live among the stones, clinging to the rough surface on the lee side.

The only other Odonate nymphs found in the course of our search at this place were a few specimens of *Macrothemis celeno* and a single one of *Scapanea frontalis.*

Afterward Dr. García-Díaz and I found *Hypolestes* occurring sparingly in three other parts of the Island, all on the north side of the central mountain range:

1. On the Maymon river just above its crossing of the Duarte Highway (Route 1) and near Piedra Blanca. This was just north of the divide and at an altitude of about 800 feet. Here I found a single cast nymphal skin sticking to the exposed top of a boulder in the stream bed a few inches above the water. Then I caught a few adults among the streamside vegetation.
2. On the Bajamillo river in the pine lands among the hills near San Jose de las Matas. Here two nymphs were sifted from among coarse gravel and small stones in the river bed, and one adult was taken in a nearby arroyo.
3. On a small river, Nigua near San Francisco de Macoris, far northward and at a much lower elevation, I got one more nymph. Sr. Alberto García Godoy, who was our guide to this place, lifted a small boulder from the river bed and this lone specimen was found clinging to the rough surface of the stone. No others were found, though many boulders were lifted and searched for them.

Thus *Hypolestes* appears to be very localized, but rather widely distributed in the island, where suitable conditions of environment remain.

The nymph of Hypolestes was described and figured by me in 1911 (*Entom. News,* 22: 137) from specimens in the Museum of Comparative Zoology. The best I could do at that time toward identifying it was to label it "An unknown nymph from Jamaica." However, I mistakenly associated it with nymphs of the Calopteryginae, because at that time damselfly nymphs having such inflated gills and lacking raptorial setae on the labium were known only in members of that group. The size and habitat of the nymph together with such venational characters as I was able to make out in the wing pads of one imperfectly preserved specimen would have justified its reference to *Hypolestes;* but I have waited thirty years for further evidence.

In January, 1934, when my naturalist colleague Dr. E. L. Palmer was visiting Jamaica I asked him to go up the Wag Water River (the

source of the M. C. Z. material) and try to find it there. After considerable searching of stones in that turbulent stream he found a single specimen that is now in the Cornell University collection. Unfortunately it was too young to show wing venation.

Now the evidence is adequate even though no nymph has been reared under control; for 1) nymphs and adults have been found together at their season of transformation in one locality in some numbers where no other Zygopterous nymphs were present, and 2) there is complete accord between the two stages in all venational characters.

The details of structure are well enough shown in my figures of 1911, but the figure of the whole nymph was reproduced from a photograph of an incomplete specimen—the best one then available. A new whole figure (Fig. 1), drawn by Dr. May Gyger Eltringham, is herewith presented.

LESTES

Four species of *Lestes* have been reported from the West Indies; none of them from Santo Domingo. In the course of my collecting in that country I found three of them: *L. forficula* was common in nearly every pond in which I did any collecting at all; *L. spumarius* I found in two very different localities; and of *L. scalaris* I saw but a single specimen, and that I took from a spider's web. Nymphs of two of the four species appear to have been made known hitherto, and I got the nymphs of the other two in Santo Domingo. Doctor P. P. Calvert adequately described and figured the nymph of *L. forficula* from Antigua (1928, 12: 8), with brief comparative notes (p. 9) on the nymph of *L. tenuatus*, reared by himself in Costa Rica. I reared the nymphs of *L. spumarius* from both of the above mentioned localities, and collected exuviae of what I take to be the fourth species *L. scalaris*. Nymphs of both are described herewith.

Dr. Elsie B. Klots (1932, p. 76) has given a key for the separation of the four species, together with adequate figures. I herewith add

A KEY TO THE NYMPHS

1.—The middle hinge of the labium extends backward only midway between the bases of the middle legs.......................... ....*tenuatus* *

—This hinge extends backward beyond the bases of the middle legs...........2.

2.—Mental setae of labium 4–5 each side; gill tips pale...... ....*forficula*

—Mental setae of labium 6 each side; gill tips blackish.................*scalaris*

—Mental setae of labium 7 each side; gill tips broadly black...........*spumarius*

* *Teste* Calvert 1927, p. 9.

Lestes spumarius Selys

This species is distinguishable from the others by its larger size (hind wing 22 mm.). Adults are more sluggish and easier of approach than other species. The superior appendages of the male are strikingly different in being much longer, not incurved to their very end, but extended beyond their point of incurvature in a pair of slender parallel tips. Adults are found in the midst of rather dense vegetation, growing in shallow permanent pools. In a pool near the mouth of the Jicomé river off the Monte Christi road, where the water was very muddy but not stagnant, I found them in a hip-high growth of *Polygonum sp. ?* hanging to the stems above the water. Nymphs were in the submerged tangle of the same stems, beneath. Transformations were taking place a few inches above the surface of the water.

I found them even more abundant in a clear-flowing mountain stream in Arroyo Sabana Miguel, near San José de las Matas. The brook was overgrown with tall weeds and rushes. A loose pile of dead brush in the midst of a stream pool was the place of greatest abundance.

The nymph may be described as follows:

Length 19 mm. plus gills 8 additional; hind femur 4; width of head 4; of abdomen 2.5.

This is a greenish species, heavily overlaid with brown. The labium (Fig. 2) is of the usual Lestine form with three lateral setae, two of which are on the movable hook, and with seven mental setae. The antennae are pale with a brown terminal segment; the relative length of the segments from the base outward is as 6:8:10:9:8:7:6. Underparts pale.

The legs are pale with brown knee-caps, femora and tibiae faintly striped with brown and with a suggestion of a subterminal ring of brown on the former. The wing cases reach backward hardly to the fifth abdominal segment. There is a wash of brown along the costal margin of each that is darkest at nodus and stigma.

The abdomen is cylindric, diffusely crossbanded with brown on the apices of the segments. There are lateral spines on segments five to nine. The one on five is small but distinct. There is a double line of paired darker dots bordering a pale middorsal stripe, and there is a submarginal longitudinal line of darker brown each side. This lateral band is widened on each of the middle segments to inclose a pale spot on each segment at its rear margin.

The gills (Fig. 2*a*) are widest before the middle, and regularly taper thereafter to bluntly rounded apices. They are heavily overlaid with brown, that color being darkest along the axis and in two diffuse cross bands one before and one beyond the middle, and there is a small brown spot on the broader side of the inequilateral base. The apical area is pale.

Lestes scalaris Gundlach

This species appears to be rather rare and local. Dr. Julio García-Díaz and I, in two months collecting in Puerto Rico found a very few specimens in two localities. In Santo Domingo I collected a single adult specimen, and that one with the aid of a spider: I found it entangled in a spider's web. The web was attached to an emergent weed that stood in the edge of a mountain pond near El Llano, province of Puerto Plata. The fine male specimen was still living, well colored, and quite adequate for determination.

Lower down on this same weed was the empty skin from which a *Lestes* had emerged. It looked as if it might once have belonged to my adult specimen until I noticed that it was the skin of a female! Nevertheless, it looked different from *L. forficula*—the other *Lestes* occurring at this pond—and on closer examination it proved to be different. Wherefore I am describing it here, and attributing it by supposition to *L. scalaris.*

The following description is based on the above mentioned cast skin.

Length 18 mm., with gills 10 mm. additional; abdomen 12; hind femur 4.

The skin is very transparent, and shows hardly any color pattern except for a narrow darkening of the joinings of the leg segments and of the abdomen. The labium (Fig. 3) is armed with the usual three lateral setae and with six mentals each side. Of the latter the fifth is a little smaller and the sixth very much smaller than the others. The middle prominence on the outer end of the lateral labial lobe between the movable hook and the end hook is itself hooklike, and not at all squarely truncated as in most other species.

The abdomen is armed with sharp lateral spines on segments 5 to 9. The gills are well enough pigmented to show a definite color pattern, but the condition of the middle gill is apparently the result of loss and regeneration; for it is only two fifths as long as the others, and is nearly colorless. The lateral gills (Fig. 3*a*) are rather heavily pigmented along the axis. The apical third of the gill is wholly suffused with brownish. The basal two thirds is paler, with two touches of brown on each margin,

and with a brown cloud on the lower broader basal angle. The gills are narrowed beyond the middle, and in their apical third the sides are nearly parallel, with the apex rounded.

This nymph differs from that of *L. forficula* in having six mental setae instead of four, in having the middle portion of the end of the lateral labial lobe more hook like, and in the general distribution of pigment of the gills.

ENALLAGMA

Five species of this genus have long been known from the West Indies.* They may be distinguished as follows:

A KEY TO THE SPECIES

Adults (males only)

1.—Abdominal segment 8 black, 9 blue; excessively slender............*truncatum*
—Abdominal segments 8 and 9 both blue, at least dorsally....................2
2.—Body dark blue or purple or violet and black; inhabits running water...*coecum*
—Body light blue and black; pond species..................................3
3.—Face all yellow............................ ....*cultellatum*
—Face pale with crossband of black on postclypeus..........................4
4.—Humeral stripe of black about as wide as the pale stripe before it; postocular pale spots narrow, transversely elongated.......................*doubledayi*
—Humeral stripe of black much narrower than the pale stripe before it; postocular pale spots roundish............... ....*civile*

Nymphs

1.—Gills about as long as abdomen...................................*truncatum*
—Gills much shorter than abdomen......................... 2
2.—Gills with heavy crossbands of brown...............................*coecum*
—Gills without distinct cross bands of brown...............................3
3.—The spinulose border of the gill ends midway of its length..........*cultellatum*
—The spinulose border ends beyond the middle.....................*doubledayi*
—The spinulose border ends before the middle.........................*civile*

The nymphs are less known than the adults. Those of three West Indian species that occur also in the United States have been described from there. They are:

1. The nymph of *E. civile,* by myself and T. D. A. Cockerell in *Psyche,* **10**: 137, 1903 from New Mexico.

2. The nymph of *E. coecum,* by myself (as "Leptobasis sp.?"; an incorrect placement by supposition) in *Proc. U. S. Nat. Mus.,* **27**: 718, 1904.

* This is omitting for the present *Enallagma cardenium* Selys, generally considered a variety of *E. coecum* Hagen.

3. The nymph of *E. doubledayi*, by Garman in his Odonata of Connecticut, p. 71, 1927.

These three species were again briefly characterized by Byers (1930) in a table of Florida nymphs, and again correctly diagnosed by Klots (1932) in a key to West Indian nymphs. Also, Dr. Julio García-Díaz (1938) in his excellent paper on Puerto Rican Odonata redescribed the nymph of *E. coecum*, and added the first description and figures of the then recently discovered nymph of *E. cultellatum*.

I wish now to add a few notes on distribution and habits of each of these species, together with a description of the nymph of the one remaining species, *E. truncatum*.

Enallagma truncatum Gundlach

This rare little Cuban damselfly, the slenderest of its genus, I collected and reared at Soledad. The place was a little weedy pond just north of Mr. Gray's house and outside the Botanical Garden. The shore where I got it was densely overgrown with the long half-floating and densely intertwined stems of a panic grass (*Panicum barbinode*). The buoyancy of the floating mat of grass stems would almost support one's weight, and collecting was difficult for it was hard to push the net through the tangle of stems. Mr. Pastor of the Garden gave me much assistance.

Among the many dragonfly nymphs obtained from this pond on the eighth of May 1937 (most of which were Libellulinae) the few that I got of the above named species were very inconspicuous. In fact I did not observe them in the field at all; but when the contents of my collecting pail were dumped out in a white dish of clean water on my laboratory table their long gills and peculiar posture * at once attracted my attention. A nymph standing on a submerged grass blade would elevate its abdomen and spread out its long lanceolate gills in perfect imitation of the swaying of slender leaves in the water. When disturbed its swimming was very like that of the larger *Lestes:* sudden darts and dashes from place to place with the swiftness of a minnow, but for a distance of only six or eight inches at each shift. I obtained but one full grown nymph along with several smaller ones. The grown one was nearly ready for transformation and I put it at once in a rearing cage. That was on the eighth of May, and I was to leave for home on the

* The posture is very like that of the nymph of *Platycnemis annulata*, that I figured in my "Dragonflies of China," Plate 18, figure 5*b*.

twelfth. Early in the morning of the twelfth I peeked into the cage, and to my great disappointment saw that it was still a nymph with no sign of immediate transformation. At the end of my packing up that forenoon I went to the cage for the last time with a vial of alcohol in hand, ready for its preservation, and to my great delight, saw that it was out of its old skin and had its adult wings fully expanded. I could allow it half an hour more to develop its color pattern before leaving for the airport and home; and as the very last act on departure I preserved it with its cast nymphal skin. The adult is a fine male specimen. From the cast skin the following characterization of the nymph is drawn.

The nymph measures in length of body 11 mm.; gills 7.5 additional; abdomen 7.5; hind femur 3; width of head 3; of abdomen 2.

The single cast skin available for description shows no color pattern at all except in the gills, and their pattern as shown in figure 4*a*, is fainter than it appeared in life. The labium (Fig. 4) is slender, with four lateral and three mental raptorial setae each side. The antenna seems to be but 6-jointed, with the joints in length about as 8:9:10:9:8:7. Perhaps the last joint represents the usual two terminal segments, which in other species are often weakly differentiated.

The gills are as long as the entire abdomen, widened posteriorly to their terminal fifth, with their margins in life slightly undulating, then contracted to a rather slender point. The serrated margin ends indistinctly at about the first third of their length and the only vestige of a transverse joint is a blackish mark on the gill axis. Beyond this there are three indefinite crossbands of darker coloration, one nearby, one where the gill begins to narrow, and a broader and more diffuse one between these two; all are mere filmy clouds that tend to be darkened a little on the gill margins.

The younger specimens show no more color pattern in the body than does the cast skin.

Enallagma coecum **Hagen**

This is a lotic species, found in practically all the streams of the Greater Antilles. I have found it the dominant species in every stream in which I have collected in Puerto Rico, Santo Domingo and Cuba, more abounding than any other Odonate whatever. It is distinguishable from other Enallagmas first of all by its darker color; dark blue, or purple, or violet striped with black. Females are sometimes green. The humeral black stripe is constricted at its upper end near the crest,

and widened by a quadrangular dilation to rearward in its lower fourth. Unfortunately, in dried specimens most of the color pattern may disappear through post-mortem changes, and as in the other species of the genus, it may become overcast with dull black.

It differs in flight also from the others. It is swifter and more elusive. When flushed by the streamside, if not taken at the first stroke of the net it is likely to escape altogether among the weeds, where it hides, and becomes undiscoverable among the dark shadows.

The species was first described by Hagen (1861, p. 84) as *E. coccum* from St. Thomas and Cuba. Later Hagen sent Cuban specimens to de Selys bearing the manuscript name *E. cardenium,* and Selys (1876, p. 530) described them under that name as a new variety. Meanwhile Scudder (1866, p. 189) had described the living colors of specimens he obtained in the Isle of Pines under the name *E. coccum.* Hagen after examining Scudder's specimens said (1873 p. 373) they were certainly *E. cardenium.* Calvert (1919, p. 350) made a careful study of all museum material available and presented figures showing such differences as he was able to discover. He concluded that *cardenium* could not be considered to be more than a variety of *coecum.* Dr. Klots (1932, p. 97) concurred in this opinion, and gave a full bibliography for the species, which need not here be repeated.

My Puerto Rican specimens come from places not far distant from nearby St. Thomas, the type locality. They show two slight trends in the form of the superior appendages of the males that differ somewhat from my Cuban specimens. The "sky-line" of these appendages in lateral view is nearly straight from end to end whereas the Cuban specimens show it more or less sagged in the middle. Also, the lower so called branch of that appendage is longer and the angle between it and the upper branch is narrower than in the Cuban specimens; and in the latter the lower branch is shorter and broader, and the angle between the branches is wider, often approaching a right angle.

There are little differences in other parts of the male superior appendages. The inferior "branch" is rather a broad downwardly projecting and incurving plate. As viewed obliquely from above it may appear rounded or truncated at the tip. It changes its appearance with each directional change of viewpoint. It may be subject to warping or other distortion in drying for its inner surface is but little chitinized. On the inner side of the upper branch at its base there is a little chitinized obliquely placed ridge whose margin may be entire or may be cut in one to four minute denticles.

Unfortunately these differences occur in individuals from the same lot and locality.

I have collected scores of specimens from widely scattered points in Cuba, in Santo Domingo and in Puerto Rico, and have reared specimens from each of these islands. I find no differences whatever in the nymphs of the entire range, and no characters by which I can set off even a variety with assurance. I have not used the name *cardenium* in this paper because I have not been able to segregate material to which to apply it. I have come to consider that all my material belongs to one highly variable species. My Dominican specimens cover the entire range of variation. They come from all parts of the Island; from southern streams in Barahona; from La Toma, the spring-fed source of San Christobal's water supply; from Aguas Muertas River near San Juan; from Maymón River near the Duarte Road crossing the central mountain range; from Jimenoa River near Jarabacoa, and from a number of streams near San José de las Matas farther north in that range; from Jicomé River in the wide valley toward Monte Christi; from rice field ditches at Vanega near Santiago and others southward of San Francisco de Macorís; from Chavón River near San Pedro de Macorís, and other rivers between Seibo and Higuey; and elsewhere.

Enallagma cultellatum Selys

Among the pond inhabiting species of Enallagma, *E. cultellatum* is easily recognized even in flight by the bright yellow color of its face. In Lake Tortuguero, Puerto Rico, where first found in 1935 by Dr. Julio García-Díaz and myself, I observed something of its habits. Females were laying their eggs in the floating leaves of *Nymphoides humboldtianum,* and on this plant only. Each female in ovipositing would perch on the leaf margin facing inward. Curving her abdomen downward and forward around the edge of the leaf with the upturned ovipositor she would make punctures in the under surface and insert an egg in each of the punctures.

In the ponds of the Botanical Garden at Soledad in Cuba, where *Nymphoides* was lacking I observed females placing their eggs in like manner in the elliptical floating leaves of a water weed *Potamogeton fluitans*. The seed spikes of this species, rising an inch or two above the surface of the water, were favorite perching places.

In Santo Domingo I found *E. cultellatum* only in the southernmost province of Barahona. It occurred sparingly in two lagoons of the plain some miles northwest of Barahona City: Laguna de los Caballeros

and Laguna Chacón. It was quite common in Laguna Fundación which is a bit of an abandoned channel in the lower flood plain of the Río Yaque del Sur a few miles from its mouth. In all of these places its most habitual Coenagrionine associate was *Ischnura ramburii.*

In flight *E. cultellatum* keeps well out from shore, beyond the denser vegetation of the water's edge, and perches on the low emergent tips of isolated water weeds close to the water. It is an artful dodger and a bit wary, and it generally flies so close to the water's surface that collecting it with a net is difficult. One is more apt to dip water with his net than to get his specimen. It is much more easily taken with a light, long-handled swatter.

I observed a curious bit of its behavior at one of the ponds in the Garden at Soledad. There was a bed of *Potamogeton fluitans*, well besprinkled with fruiting spikes protruding above the water, and there was one of these spikes about half an inch taller than the others, and on that account, a favorite perch for several low-flying Odonata. The species that dominated the situation and that occupied this perch most of the time was the Libelluline, *Micrathyria aequalis;* but our little yellow-faced *cultellatum* also liked that perch and was a persistent contender for it. Although driven from the immediate vicinity by repeated charges of a dragonfly many times its own size, *cultellatum* would dodge around its big opponent, keeping just out of reach. As soon as the *Micrathyria* was settled again on the top of the seed spike, the little *cultellatum* would reappear, darting here and there, keeping so close to the surface of the water as to be unapproachable from the air by a Libelluline. Soon it would slip up to the perch from the rear and settle itself on the side of it just above the water line and within an inch or two of the *Micrathyria* seated on the top. This caused the *Micrathyria* evident annoyance; for it would rise in the air, wheel about and come charging down directly toward the little fellow, driving it away again.

This I saw happen again and again while I quietly collected nymphs at the shore near by. Clearly the *Micrathyria* was trying to drive the little intruder from his domain; and it looked as if the little fellow was enjoying the big fellow's discomfiture. Among Corduline dragonflies I have seen a small and agile *Tetragoneuria* pestering a big *Epicordulia* in flight, darting all about it, keeping out of its reach and driving it from the neighborhood (much as a kingbird may embarrass and drive away a crow), but I had never before seen two such contenders as these for the same perching place.

Enallagma doubledayi Selys

This species, that is so common in the southeastern United States, is apparently very uncommon in the West Indies. I have not collected it there, and the only specimens that I have seen from that source are a few that were collected at Placelas, Santa Clara Province, Cuba by Dr. J. Acuña, and kindly sent me by Dr. C. S. Bruner.

Enallagma civile Hagen

This widely ranging species is generally distributed about the borders of ponds in all the Greater Antilles, but I have nowhere found it very common there. It is much more abundant in many places in the United States. In stature it is larger than any other of the West Indian species of the genus, and it shows a brighter blue coloration. In Santo Domingo I found it in places as different as the little mountain pond in the north coastal range at El Llano, and in the ditches of the rice fields near sea level. Being a good flyer it strays widely from the place of its nativity, and is one of the first damselflies to appear in newly constructed ponds. I found it in a new-made (second season) concrete pool behind the Biology Building on the campus of the University of Puerto Rico. Its associates there were strong flying Anisoptera: *Pantala flavescens, Tramea abdominalis*, and *Orthemis ferruginea.*

LEPTOBASIS

Until my last trip to Santo Domingo in 1940 I had not seen this dainty little damselfly alive, and the poor little faded specimens that I had seen in various collections had given me no idea whatever of its singular beauty of coloration. Old faded teneral specimens stuck on pins—their bodies hardly wider than the pins that impale them—have hardly more color than bits of broomstraw. I had a delightful surprise, therefore, when on a collecting trip with Dr. Julio and Mrs. García-Díaz on June fifteenth we found a colony of *Leptobasis vacillans* Selys.

The place was a pool in the Jicomé River near its junction with the Yaque del Norte, perhaps half way between Esperanza and Monte Christi. The pool was a mere dilation in the river. It was half overgrown with jointweed (*Polygonum* sp.?). Elsewhere in this lower sluggish portion of the stream no rooted aquatic vegetation was seen; but this pool was excluded from surrounding pastures by fences, and so, was exempt from trampling by cattle. The water in it was muddy, due to inflow from the pastures. The surrounding floodplain soil prob-

ably contained some salt; for cattle were seen licking at the white deposits left upon the baked mud where shallow pools had completely evaporated.

Dr. García-Díaz first discovered the dainty little damselfly under cover of some low bushes that grew on a bank beside this pool. First he saw a mere shadow flit from one twig to another. Then he captured a red male; then a red female; then a green female, and then the hunt for more was on!

The coloration of *L. vacillans* in life has an elegance and a brillance that would never be suspected from an examination of the usual museum specimens. The younger red specimens are a rich carmine above shading off to honey yellow beneath in male and female alike. Darker markings are confined to mere hair-lines of black on the edges of the carinae about the wing roots, a Y-mark on the top of the prothorax, a small streak on the top of each side of the head beside a lateral ocellus, and a cross line on the apex of each of the middle abdominal segments. The legs are pale yellow with a touch of black above each knee and with black spines.

I speak of these red specimens as "young" ones with confidence, because I have watched their assumption of this color after emergence from the nymphal skin. They are a very pale yellow on emergence but very quickly become bright red on the dorsum. Later, if they escape their many enemies, they undergo a very remarkable change of coloration and look so different that I took the first I found to represent a different species.

It appears from Dr. P. P. Calvert's account of this species in *Biologia Centrali Americana* (p. 221) that he had the same impression when he began comparing red specimens with black-and-green ones. He could find no structural differences between them. Lacking intermediates, he called the maturely colored specimens by the appropriate descriptive name, var. *atrovirens*. In my own more extensive lot of freshly gathered material both young and old specimens are present, together with intermediates; and the latter seem to show that the color differences merely indicate age differences. The color changes are limited to the top of the head and face and to the front and sides of the thorax. They run parallel in the two sexes.

The prettiest specimens are found among the intermediates in age. The mantle of red overspreading head and thorax changes to olive green, with stripings upon the synthoracic dorsum of rich golden amber brown, that will later change to deep black. Of the three broad stripes

one is middorsal and two overlie the humeral sutures. The three at maturity become united across the crest sharply delimiting and circumscribing the intervening stripes of green. The top of the head and prothorax also partake of the same color changes. A small greenish twinspot on the middle lobe of the prothorax takes on when older a slightly yellowish tinge. Two specimens that may possibly be older than any of the others, have the stripings of a purplish color, overcast with a small measure of pruinosity.

The midventral spine on the eighth abdominal segment of the female is very weak or frequently altogether wanting.

By collecting among the weed beds of the Jicomé River pool I found that that was the place from which the adults were emerging. Very pale teneral specimens fluttered away when the weeds were invaded: only tenerals and red specimens were found in the weeds, and their flights were mainly shoreward. The older green and black forms were found out among the bushes on the banks, and they are much less easily captured. I was unable to see any of them until they took flight. Then it was necessary to catch them quickly; for when flushed from one resting place they would go ever deeper into the clumps of bushes and after two or three short flights would invariably be lost.

I found the nymphs clinging to the submerged stems of *Polygonum;* not in the mats of floating algae, and not on the bottom. They climb just above the surface of the water for transformation. Their most abundant Odonate associates were nymphs of *Lestes spumarius,* some of which were found transforming at the same time. Three other Zygoptera were found there sparingly: *Enallagma civile, Enallagma coecum,* and *Ischnura ramburii.*

Other localities in which I later found *Leptobasis* in Santo Domingo were Arroyo Sabana Miguel near San José de las Matas, and a brook in a pasture near Castillo, eastward from San Francisco de Macorís.

Leptobasis vacillans, nymph reared

Length 10 mm. plus gills 5 mm. additional; hind femur 3; width of head 3; of abdomen 2.

This is a slender little nymph (Fig. 5), brownish or greenish in color, with faint longitudinal streaks of darker color along the sides of the whole body. The legs are pale brownish with hardly any indication of darker bandings. The antennae are about as long as the head is wide: the seven segments are in relative length about as 6:7:10:8:6:6:5. They are very pale beyond the two basal segments. The labium is

moderate, the hinge reaching backward just to the middle coxae. The mentum widens rather regularly from the hinge forward. It is armed with five lateral and five mental setae. The end of the lateral lobe is as shown in figure 5*a*.

The wings reach backward well upon the fifth abdominal segment. The gills (Fig. 5*b*) are lanceolate, long pointed, widest at three fourths their length. The serrate-spinulose border before it ends in a triangular denticle. The tracheation is rather wide-meshed and very irregular, as shown in the figure.

Two specimens one of each sex, collected at Arroyo Sabana Miguel, three miles northwest of San José de las Matas on June 22nd, transformed in my cages on June 24th.

LITERATURE CITED

Byers, C. F. A Contribution to the Knowledge of Florida Odonata. *Univ. of Fla.; Biol. Sci. Ser.* **1**: 1–327, 11 pls. and text figs., 1932.

Calvert, P. P. *Biologia Centrali Americana: Leptobasis*, pp. 120–121, 1902.

————. Gundlach's Work on the Odonata of Cuba. *Trans. Amer. Ent. Soc.* **45**: 335–396, 1919.

————. Report of Odonata, including Notes on Some Internal Organs of the Larvae. *Univ. of Iowa Studies in Nat Hist.* **12**: 3–44, 5 pls., 1927.

García-Díaz, Julio. Ecological Survey of the Aquatic Insects of Puerto Rico: I Odonata. *Jour. Agr. Univ. Puerto Rico* **22**: 43–97, 1938.

Garman, Philip. Guide to the Insects of Connecticut · V. Odonata. *State Geol. and Nat. Hist. Surv. Bull.* **39**: 1–331, 21 pls, 1927.

Hagen, H. A. Synopsis of the Neuroptera of North America. *Smithsonian Misc. Coll.*, pp. 1–336, 1861.

Klots, Elsie Broughton. Insects of Puerto Rico and the Virgin Islands: Odonata. N. Y. Acad of Sci.; *Sci. Surv. of P. R. and the Virgin Is.* **14**: 108; 7 pls., 1932.

Needham, J. G. New Dragonfly Nymphs in the U. S. Nat. Museum. *Proc. U. S. Nat. Mus.* **27**: 685–720, 1904.

————. Description of Dragonfly Nymphs of the Subfamily Calopteryginae (Odonata). *Ent. News* **22**: 143–154, 2 pls., 1911.

————. The Nymph of the Protoneurine Genus Neoneura. *Ent. News* **50**: 241–245, figs., 1939.

Needham, J. G. and **Cockerell, T. D. A.** Some hitherto unknown Nymphs of Odonata from New Mexico. *Psyche* **10**: 134–139, 1903.

Needham, J. G. and **Fisher, Elizabeth.** The Nymphs of Libelluline Dragonflies (Odonata). *Trans. Amer. Ent. Soc.* **62**: 107–116, 2 pls., 1936.

Scudder, S. H. Notes on Some Odonata from the Isle of Pines. *Psyche* **10**: 134–139, 1866.

Selys, E. de. Synopsis des Agrionines; 5me Legion. *Bull. Acad. Belg* (2) **42**: 247–539, 1876.

EXPLANATION TO THE FIGURES

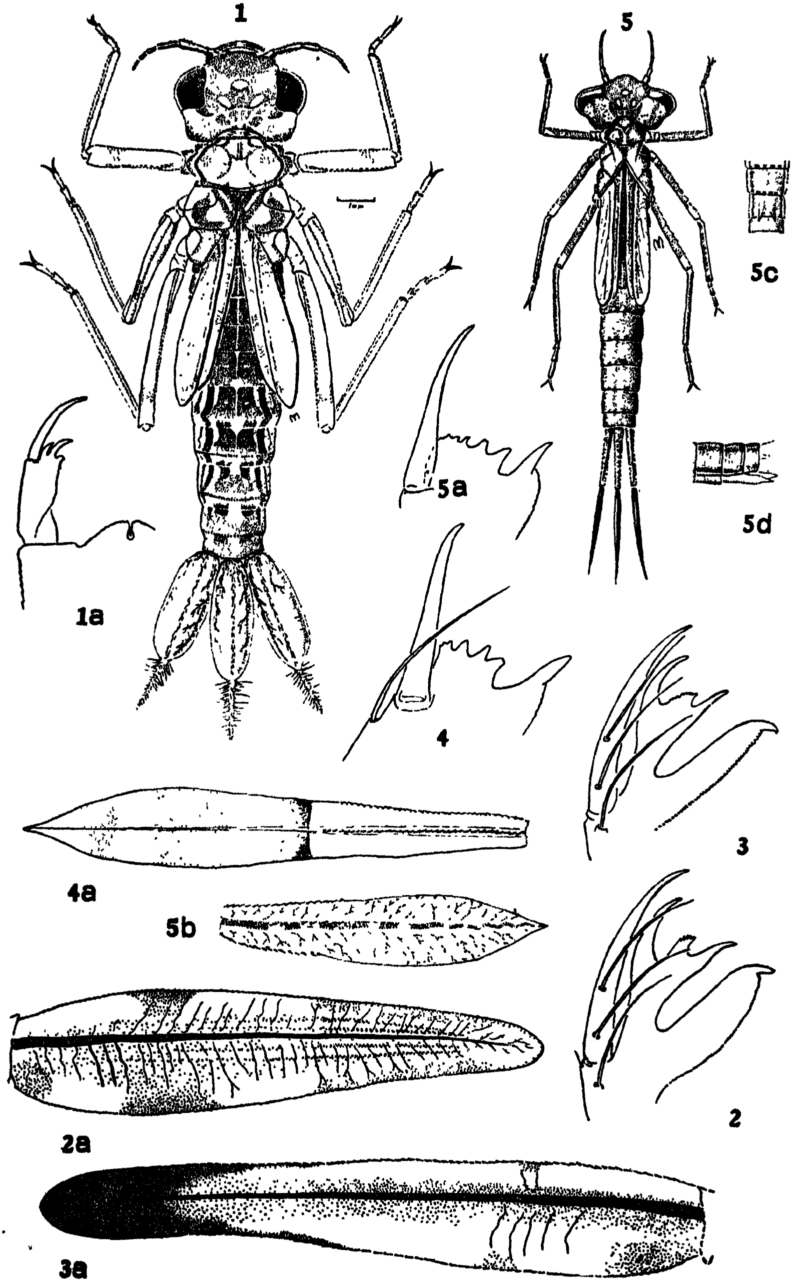
FIG. 1. *Hypolestes clara* Calvert, whole nymph; *1a*, end of labium showing median and lateral lobes.

FIG. 2. *Lestes spumarius* Selys, lateral lobe of the labium; *2a*, median caudal gill.

FIG. 3. *Lestes scalaris* Gundlach, lateral lobe of the labium; *3a*, lateral caudal gill.

FIG. 4. *Enallagma truncatum* Gundlach, end of lateral lobe of labium; *4a*, median caudal gill.

FIG. 5. *Leptobasis vacillans* Selys, whole nymph; *5a*, end of lateral lobe of the labium; *5b*, median caudal gill; *5c*, male, and *5d*, female, end of abdomen showing sex characters of the nymph.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A REPORT OF SOME INVESTIGATIONS ON THE CORN INSECTS OF PUERTO RICO

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During the period August 1935 to June 1936 studies were made by the Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture on insects attacking growing corn in Puerto Rico. These studies were financed from a special fund provided by the Department for the purpose and were conducted in cooperation with the experiment station of the United States Department of Agriculture at Mayagüez and the substation of the Agricultural Experiment Station of the University of Puerto Rico at Isabela.

As a result of these studies the following four species of insects were determined to be of prime economic importance to the corn crop of Puerto Rico: The corn leafhopper (*Peregrinus maidis* Ashmead), the otitid (ortalid) fly *Euxesta stigmatias* Loew infecting the ears, the fall armyworm (*Laphygma frugiperda* (A. and S.)), and the corn earworm (*Heliothis armigera* (Hbn.)). The corn leaf aphid (*Aphis maidis* Fitch) and the sugarcane borer (*Diatraea saccharalis* (F.)) were found in varying numbers, but little damage by them was noted. Control experiments were conducted with the fall armyworm and the corn earworm.

Because of the tropical climate and the varied topography of the island, there is wide variation in rainfall, this ranging from 30 to over

[1] Sincere appreciation is due to H. Atherton Lee, Director of the Agricultural Experiment Station at Mayagüez, for providing land and assistance, to R. L. Davis, agronomist at the station, who provided seed and gave valuable suggestions for growing the crops under Puerto Rican conditions, and to Luis A. Serrano, director of the Isabela substation of the Agricultural Experiment Station of the University of Puerto Rico, who provided land and seed and gave much valuable assistance at Isabela.

100 inches annually in different locations. The average variation between mean summer and mean winter temperatures is about 5 Fahrenheit degrees. Corn can be grown at all seasons of the year in locations where there is sufficient rainfall, and can be grown at any time in those areas that have been adapted to irrigation. Therefore corn in all stages of development can be found at any time. There was also found to be a great overlapping of the generations of corn insects, as eggs, young in all stages of development, and adults could be found at the same time in the same field.

THE CORN LEAFHOPPER

Peregrinus maidis Ashmead

In a survey of the island made in September and October 1935 no field was found in which the corn leafhopper was not present, and little difference in abundance was noticed in the different sections of the island. Fields averaged from 5 to 83 percent of the plants infested. Large numbers of these insects develop in the whorls of young plants and around the ear buds of older plants. Their feeding causes many young plants to wither and die, but the damage to older plants is not apparent. The greatest importance of the corn leafhopper is in the fact that it is the vector of corn yellow stripe disease, to which native varieties of corn are resistant but the exotic varieties very susceptible.

Euxesta stigmatias Loew

The larvae of the dipteron *Euxesta stigmatias* were found infesting the ears of corn in the roasting-ear stage. A large majority of the ears in fields in all sections of the island were infested. The eggs of this fly are deposited on the silks of the ears. The young larvae hatch in 2 to 4 days and feed for a short time in the silks, later working down into the developing grain. The tips of many ears are damaged and often entire ears are destroyed. The greatest damage probably consists in the unsightly appearance and malodorous condition imparted to roasting ears. The fly may pass through a complete generation in 18–24 days. Certain observations on this insect were presented in a previous publication.[2]

[2] App, Bernard A. *Euxesta stigmatias* Loew, an Otitid Fly Infesting Ear Corn in Puerto Rico. JOUR. AGR. UNIV. PUERTO RICO 22 (2): 181–188, illus. 1938.

THE FALL ARMYWORM

Laphygma frugiperda (A. and S.)

The larvae of the fall armyworm were found to be abundant in all sections of the island and present at all seasons. The eggs of this insect are laid in a mass on the leaves of young corn plants. The newly hatched larvae feed on the leaves, later moving into the whorl, where they consume a large quantity of leaf surface, often destroying the entire whorl and killing the plant. Eggs are also deposited on older plants and the developing larvae feed in the young ears, often entering from the side and between the leaf sheath and the ear. The average developmental period for 53 individuals raised in the laboratory from egg to adult was 35.6 days, so it is believed that many generations occur in a single year. Many larvae of this insect were observed to develop on malojillo grass (*Panicum purpurascens* Raddi), and severe damage was noticed in a field of corn that had previously been in grass. In this field the partly grown larvae attacked the young corn in cutworm style.

CONTROL MEASURES

Poisoned Bait.—In the case of partly grown larvae attacking corn after the manner of cutworms, an application of standard poisoned-bran bait gave good results. Paris green was used as the toxic agent in the bait.

Dusts.—Three different experiments were conducted to test the effectiveness of dusts for the control of the fall armyworm. All were applied with a large plunger-type hand duster having a short extension pipe ending in a fan-shaped attachment that directed the dust into the whorl of the young plants. About 8.5 pounds of dust per acre was required for small plants and as much as 18 pounds per acre for larger plants. In November 1935, at Mayaguez, four different dusts were tested in a randomized block arrangement replicated four times. Each plot was 10 by 15 hills in size and averaged about 1,000 plants per treatment. Three applications were made at 10-day intervals beginning November 9, when the plants were about 15 days old, and ending November 29, after which time it was thought that further dusting was impractical. Infestation counts were made on December 10, 1935, and the results are shown in table 1.

Because of the low percentage of control obtained in the previous test some changes were made in the experiments conducted during March

TABLE 1. *Efficacy of various dusts for the control of the fall armyworm. Mayagüez, P. R., November–December 1935*

TREATMENT	PLANTS	PLANTS INFESTED	CONTROL [1]	PLANTS BURNED
	Number	*Percent*	*Percent*	*Percent*
Lead arsenate and talc 1 : 4	1,116	31.0	53.5	19.9
Lead arsenate and talc 1 : 9	1,049	32.7	51.0	17.4
Pure dusting sulfur	973	59.0	11.5	0
Derris and talc 1 : 4	1,054	65.7	1.5	0
Check	1,051	66.7	—	—
Required significant difference for odds of 19 to 1		8.00		
Required significant difference for odds of 99 to 1		11.22		

[1] Percent controls computed from the formula $\frac{X - Y}{X} \times 100$, where X equals the percent infested in the check plots and Y equals the percent infested in the treated plots.

and April 1936. Experiments were conducted at Mayagüez and Isabela, and were each replicated 5 times. The plots at Mayagüez were 5 by 15 hills in size, totaling about 370 plants per treatment. At Isabela, where the corn was planted in drill rows, the field was divided into five blocks subdivided into plots running the length of the field. Treatments were applied to a single row in each plot. A buffer row of untreated corn was left on each side of the treated row. Each treated row contained about 140 plants, making approximately 700 plants per treatment. Dusting was done at weekly instead of 10-day intervals and was continued until the plants began to tassel. Sulfur was omitted from this test because it had failed to show significant results in the November-December trials and because of its high cost in Puerto Rico. The lead arsenate in the proportion of 1 part to 4 of talc was also omitted, since the results obtained in the previous experiment were no better than those obtained with the mixture with less arsenate. Derris was included but made slightly stronger by using 3 parts of talc to 1 of derris (4 percent rotenone) to give about 1 percent of rotenone in the dust. Barium fluosilicate in the proportion of 1 part to 9 of talc, and magnesium arsenate at the same dilution, were included in these tests. Table 2 shows the results of the tests at Mayagüez and Isabela during March

and April. In these trials the dusts were applied at weekly intervals, at Mayagüez beginning March 18 and ending April 15, and at Isabela beginning March 23 and ending April 13.

An analysis of the variance of the three experiments for the control of the fall armyworm is given in table 3. All three experiments showed some highly significant differences among the treatments. The required differences necessary for two means to differ significantly were computed and recorded in tables 1 and 2. In table 1 it is seen that there were no real differences between the results with derris and with sulfur and in the check. The two mixtures of lead arsenate show highly significant differences from the check but do not differ significantly from one another. In the experiments at Mayagüez and Isabela completed in June 1936 all the treatments show a highly significant difference from the check with lead arsenate, showing a significant advantage over the other materials. The somewhat better control obtained in April may be due to dusting at weekly rather than at 10-day intervals. All mixtures of lead arsenate burned some of the plants, but no serious damage occurred. Barium fluosilicate burned the plants rather severely, killed some of them, and appeared to stunt the growth of others.

TABLE 2. *Efficacy of dusts for the control of the fall armyworm, Puerto Rico, March–April, 1936*

TREATMENT	EXPERIMENT AT MAYAGÜEZ				EXPERIMENT AT ISABELA			
	PLANTS	PLANTS INFESTED	CONTROL	PLANTS BURNED	PLANTS	PLANTS INFESTED	CONTROL	PLANTS BURNED
	Number	*Percent*	*Percent*	*Percent*	*Number*	*Percent*	*Percent*	*Percent*
Lead arsenate and talc 1 : 9	392	8.4	88.2	25.6	753	22.8	70.6	35.7
Barium fluosilicate and talc 1 : 9	376	23.9	66.4	32.5	713	35.8	53.9	64.7
Derris and talc 1 : 3	371	38.2	46.3	0	745	49.9	35.7	0
Magnesium arsenate and talc 1 : 9	383	58.2	18.3	0	714	60.3	22.3	0
Check	359	71.2	—	—	714	77.6	—	—
Required significant difference for odds of 19 to 1		8.40				8.12		
Required significant difference for odds of 99 to 1		11.57				11.19		

TABLE 3. *Analysis of variance of the efficacy of dusts for the control of the fall armyworm in Puerto Rico, 1935–1936*

SOURCE OF VARIATION	LOCATION AND DATE OF EXPERIMENTS					
	MAYAGÜEZ NOVEMBER 1935		MAYAGÜEZ APRIL 1936		ISABELA APRIL 1936	
	DEGREES OF FREEDOM	MEAN SQUARE	DEGREES OF FREEDOM	MEAN SQUARE	DEGREES OF FREEDOM	MEAN SQUARE
Blocks . . .	3	17.03	4	78.20	4	189.85
Treatments	4	1,262.24*	4	3,198.50*	4	2,259.27*
Error . . .	12	26.98	16	39.22	16	36.65

* Highly significant.

THE CORN EARWORM

Heliothis armigera (Hbn.)

Earworms were found to be abundant in Puerto Rico and usually were infesting a large percentage of the ears. In the survey of corn insects made in August and September 1935 no field of corn in the ear stage was found in which this insect was not present. Considerable damage was also noticed to peppers and tomatoes. In the examination of several tobacco fields no earworms were noted. Some observations on the percentage of ears infested with earworms on different dates during the year are given in table 4.

TABLE 4. *Percentage of ears found infested with larvae of the corn earworm in various fields at different seasons in Puerto Rico*

DATE	LOCATION	EARS INFESTED
		Percent
1935		
August 19	Mayagüez	52.0
August 19	do.	81.0
September 23	Isabela	39.0
September 23	Hatillo	75.0
October 14	Mayagüez	56.0
October 14	Isabela	69.0
November 6	do.	43.0
1936		
January 8	Lajas	87.0
February 3	Mayagüez	27.8
May 11	Isabela	61.4
June 1	Mayagüez	55.5
June 5	Isabela	46.9

CONTROL EXPERIMENTS

Three experiments were conducted to test different methods of control for the corn earworm under Puerto Rican conditions. A randomized block arrangement was used in these experiments, the first, completed in February 1936, replicated four times, and the later experiments, completed in June 1936, replicated five times. A tropical sweet corn USDA–34, developed at the experiment station at Mayagüez, was grown for the tests. In the tests at Mayagüez and completed in February, each plot was 5 by 15 hills in size and averaged about 175 ears per treatment of four replications. In the trials completed in June 1936, plots at Mayagüez were 6 by 15 hills, with an average of approximately 350 ears for the five replications. At Isabela, where the corn was planted in drill rows, each plot consisted of a single row running the length of the field. Each plot averaged about 140 plants each and produced an average of over 500 ears per treatment in five replications.

Chemical controls consisted of insecticides applied in dust form early in the morning while the silks were moist with dew. All dusting was done by hand with a small plunger-type duster that directed the dust to the silks. In the experiment at Mayagüez, completed in February, dusting was begun near the mean silking date and continued until the silks had dried. Four applications of dust were made on December 27 and 30, 1935, and January 2 and 5, 1936. In an attempt to obtain a higher percentage of control in later experiments, applications of dust were begun as soon as a few silks appeared and continued until they dried. In the trials completed in June 1936 dusting was done as often as twice a week. Seven applications were made at Mayagüez beginning May 1 and ending May 27, and seven at Isabela beginning May 3 and ending May 24. The results are summarized in table 5.

An analysis of variance (table 6) of the three experiments gives evidence of some highly significant differences between the treatments. Differences required for significance are given in table 5. In all three trials barium fluosilicate showed a highly significant difference from the check. However, the percentages of control were not high enough to warrant its use. Derris showed significance from the check in two of the three experiments. Arsenates of magnesium and lead showed significance in only one out of three experiments, and their percentages of control were very poor. In spite of the significant reductions, none of the insecticidal materials tried gave sufficient control to be of value.

The mechanical and manual methods of control were all designed to prevent the young larvae from working down through the silks to the

TABLE 5. *Efficacy of dusts for the control of the corn earworm, Puerto Rico, 1936*

TREATMENT	TEST AT MAYAGÜEZ COMPLETED FEBRUARY 3			TEST AT MAYAGÜEZ COMPLETED JUNE 1			TEST AT ISABELA COMPLETED JUNE 5		
	EARS	EARS INFESTED	CONTROL	EARS	EARS INFESTED	CONTROL	EARS	EARS INFESTED	CONTROL
	Number	*Percent*	*Percent*	*Number*	*Percent*	*Percent*	*Number*	*Percent*	*Percent*
Barium fluosilicate and talc 1 : 1...	161	11.8	57.6	361	36.3	34.6	542	30.2	35.6
Derris and talc 1 : 3..........	186	17.9	35.6	357	48.8	12.1	533	33.7	28.1
Magnesium arsenate and talc 1 : 4...........	193	22.6	18.7	339	47.2	15.0	546	33.7	28.1
Lead arsenate and talc 1 : 4..... ..	209	27.3	1.8	354	49.4	11.0	538	36.7	21.8
Check...........	223	27.8	—	321	55.5	—	552	46.9	—
Required significant difference for odds of 19 to 1...........		8.28			8.69			7.01	
Required significant difference for odds of 99 to 1..... . . .		11.61			11.97			9.65	

TABLE 6. *Analysis of variance of chemical tests used against the corn earworm, Puerto Rico, 1936*

SOURCE OF VARIATION	LOCATION AND DATE OF EXPERIMENTS					
	MAYAGÜEZ FEBRUARY		MAYAGÜEZ JUNE		ISABELA JUNE	
	DEGREES OF FREEDOM	MEAN SQUARE	DEGREES OF FREEDOM	MEAN SQUARE	DEGREES OF FREEDOM	MEAN SQUARE
Blocks.....	3	42.51	4	22.42	4	14.25
Treatments.	4	181.35*	4	244.56*	4	205.49*
Error......	12	28.91	16	42.04	16	27.34

* Highly significant.

developing grain. The plots were examined twice weekly, and those ears that had silked were treated. This process was continued until the corn finished silking. The following methods were used: (1) A hog ring was clamped around the tip of the ear by the use of special pliers; (2) a piece of light-weight brown wrapping paper about 4 by 6 inches was wrapped around the tip of the ear and tied with a string to form a paper cap over the silks and ear tip; (3) a piece of No. 18 soft galvanized wire was placed around the ear tip and tightened with a pair of pliers;

TABLE 7. *Efficacy of mechanical and manual methods for the control of the corn earworm in Puerto Rico, 1936*

	TEST AT MAYAGUEZ COMPLETED FEBRUARY 3			TEST AT MAYAGUEZ COMPLETED JUNE 1			TEST AT ISABELA COMPLETED JUNE 5		
	EARS	INFESTED EARS	CONTROL	EARS	INFESTED EARS	CONTROL	EARS	INFESTED EARS	CONTROL
	Number	*Percent*	*Percent*	*Number*	*Percent*	*Percent*	*Number*	*Percent*	*Percent*
Hog rings	224	5.0	82.0	342	5.9	89.4	523	5.1	89.1
Paper caps	127	4.0	85.6	304	8.2	85.2	518	8.5	81.9
Wires	172	5.2	81.3	—	—	—	490	6.3	86.6
Strings	163	6.6	76.3	—	—	—	518	11.6	75.3
Cut silks	201	9.4	66.2	338	22.3	59.8	528	17.9	61.8
Squeezing the tips	198	14.2	48.9	336	27.2	51.0	514	23.0	51.0
Check	223	27.8	—	321	55.5	—	552	46.9	—
Required significant difference for odds of 19 to 1		7.26			6.48			3.43	
Required significant difference for odds of 99 to 1		9.95			8.92			4.65	

(4) a piece of string was tied around the ear in a similar manner; (5) the silks were cut off with a pair of scissors; and (6) the tips of the ears were squeezed by hand. Care was exercised in applying those methods that might interfere with pollination. In the application of hog rings, strings, and wires, room enough for the ear to develop was allowed. Results of the mechanical and manual methods are presented in table 7.

Analysis of the data by the variance method (table 8) shows that there are some highly significant differences among the treatments, and the amounts by which two treatments must differ to be significant are

shown in table 7. It will be noted that all the treatments showed highly significant differences from the check in all the experiments. Hog rings gave the best control in two out of three trials, with the wires, paper caps, and strings nearly as good. By the use of special pliers the hog rings could be applied more rapidly and easily than the other treatments, and under labor costs in Puerto Rico at about $15 for an acre of 8,000 ears. Cutting the silks, after pollination, showed a reduction of infestation over the check, but the tips of the ears thus exposed became ideally suited to oviposition by the fly *Euxesta stigmatias*, and as a result large numbers of ears so treated became maggot infested. The materials for the paper caps were cheap but the labor necessary in their application increased their cost. The applications of strings would cost approximately $9.47 per acre of 8,000 ears. With a good market price for sweet corn, the use of some of these methods would be feasible. It is possible that a lighter, cheaper ring could be substituted for the hog ring at a lower cost. All these methods of protection gave such encouraging results that they should be further investigated.

TABLE 8. *Analysis of variance of mechanical and manual methods used for the control of the corn earworm in Puerto Rico, 1936*

SOURCE OF VARIATION	LOCATION AND DATE OF EXPERIMENTS					
	MAYAGÜEZ FEBRUARY		MAYAGÜEZ JUNE		ISABELA JUNE	
	DEGREES OF FREEDOM	MEAN SQUARE	DEGREES OF FREEDOM	MEAN SQUARE	DEGREES OF FREEDOM	MEAN SQUARE
Blocks	3	25.33	4	10.13	4	16.08
Treatments	6	286.39*	4	1,974.72*	6	1,077.23*
Error	18	23.90	16	23.37	24	6.90

* Highly significant.

SUMMARY

Investigations of the corn insects of Puerto Rico were made during the period extending from August 1935 to June 1936. Four species of insects were found of importance to the corn crop of the island, viz, the corn leafhopper, the otitid fly *Euxesta stigmatias*, the fall armyworm, and the corn earworm.

Three experiments were conducted with dusts against the fall armyworm. In these lead arsenate gave the best results, with control up to

88.2 percent. Barium fluosilicate was less satisfactory. Some improvement appeared to be gained from dusting at weekly rather than at 10-day intervals.

Chemical, mechanical, and manual methods were tried against the corn earworm. Of the chemicals, barium fluosilicate gave the best control, but burned the plants severely. Although some significant degrees of control were obtained, none of the insecticides gave encouraging results against the corn earworm. Mechanical and manual methods designed to prevent the larvae from working from the silks to the grain gave good results. The application of hog rings, paper caps, strings, and wires all gave substantial control. Because of the promising results obtained, these methods would appear to be worthy of further study.

NEW BIRD RECORDS AND SOME NOTES FOR THE VIRGIN ISLANDS

By Harry A. Beatty

Christiansted, St. Croix, V. I., U. S. A.

This paper is an account of observations and collections I made on St. Croix, St. Thomas, St. John, Tortola, Virgin Gorda and numerous small outlying islands and cays.

In this account I have included species which were previously recorded from the Virgin Islands but are now placed on record for the first time as breeding birds. Among the rare finds was the discovery of a small colony of nesting Blue-faced Booby (*S. d. dactylatra*).

It seems highly improbable that the Quail-dove, *Oreopeleia montana montana,* at one time winged its way through the jungles of St. Croix. If that were true then we ought, perhaps, to assume that the species disappeared some time during the short period of sixty years and another form emerged upon the scene and today has become fairly common. My desire to take specimens of *montana* has spurred me on to find it here since 1918. A search on St. Thomas for *montana* has likewise been unsuccessful. I looked for it during a total time of six weeks over a three year period on six different trips. Peters, in his Check-list of Birds of the World, Vol. 3, makes no mention of any St. Croix record and indicates that the record for St. Thomas is questionable. However, if it does occur there it must be extremely rare while today *O. m. beattyi* is the prevalent form although an extremely shy bird due in greater part, no doubt, to the continuous persecution by gunners. The Quail-dove on St. Croix is an unsuspicious bird not harassed by gunners and well protected by sentiment and legislation.

On Tortola, B. V. I., the Quail-dove is unknown by all its familiar names. The natives will insist that they know only of a "Marmee-dove" in the woods. On March 13, 1941, while on a visit to that island, eight birds came under observation and several specimens were taken. All were of one species. I also learned that the Marmee-dove is very uncommon and greatly restricted in its range. On Virgin Gorda I searched an entire afternoon on April 22nd for the Quail-dove, ever on the alert to catch a song, but nothing was heard nor seen of it.

Puffinus lherminieri lherminieri.—Audubon Shearwater. Little Saba Cay: March 10, 1941. Eggs in nest-holes. April 16, 1941. Downy young in nests. A number of adults were taken from nest-holes and prepared as skins, among them were 5 males and 5 females. I cite this species to record the observation that both sexes shared in the incubation. Each bird collected was sitting on an egg. Later, the downy young alone were occupying the nest-holes.

Phaethon aethereus mesonauta.—Red-billed Tropic-bird. Cockroach Cay: Two pairs, nesting in cliffs, were observed first on March 11th and again on April 17, 1941. On Virgin Gorda two pairs were nesting in cliffs west of Gorda Sound, April 22, 1941.

Phaethon lepturus catesbyi.—Yellow-billed Tropic-bird. Little Saba Cay: An immature was taken from its nest on April 16, 1935. Water Island: March 21, 1941, ten pairs were nesting in high cliffs. Dutchmans Cap: July 11, 1940, a pair was seen taking food to a young bird on the rocks. Virgin Gorda, April 22, 1941. Two pairs were nesting in cliffs at Gorda Sound.

Sula dactylatra dactylatra.—Blue-faced Booby. Cockroach Cay: April 17, 1939. Four adults were seen, one bird occupying an unlined nest containing two eggs. March 30, 1940, I saw eight adults and a nest occupied by one snow white downy young. On July 12, 1940, ten adults were seen; a nest with one egg and another with one big fluffy downy. On March 11, 1941, I saw ten adults and two nests containing two eggs each guarded by adults. Another nest held a very big fluffy nestling with which I played at "pecking" while the parent bird nestled up close and looked on approvingly. One immature was seen on the wing.

Fregata magnificens rothschildi.—Frigate-bird. Little Tobago Cay: March 13, 1940. I visited the cay for data but rough seas made landing impossible. About 200 adults and many white headed immatures were on the wing. Local fishermen tell me that nesting begins about January.

Circus cyaneus hudsonius.—Marsh Hawk. St. Croix: A new record was added to the fauna when fifteen of these hawks were seen on November 2, 1940. Each bird was in the brown phase and several of them could be seen daily until April 16, 1941. A specimen was taken on November 9, 1940, and another on January 15, 1941.

Pandion haliaetus carolinensis.—Osprey. St. Thomas: Mr. Nichols tells me that he had seen two nestlings which he recognized as this species. They had been removed from a nest on the cliffs of an unidentified cay somewhere in the Tortola area. The time was about March in 1940.

Falco peregrinus peregrinus.—European Duck-hawk. St. Croix: At dusk, November 9, 1940, I collected a Duck-hawk. The specimen was included in a package of skins sent to Dr. Louis B. Bishop. Dr. Bishop has written to tell me that he considers it to be the European Falcon. This is a new record for St. Croix, and for the West Indies.

Oxyechus vociferus rubidus.—Antillean Killdeer. St. Croix: The antillean killdeer was first recorded on September 26, 1939. A pair caring for two downy young was seen on October 28, 1939, and again on February 10, 1941, another pair was found with three downy. This is a first record for the island.

Ereunetes mauri.—Western Sandpiper. St. Croix: Several specimens were taken in August and September, 1939. A new record.

Larus atricilla.—Laughing Gull. Flat Cay: June 26, 1940, a colony of 100 adults, 10 nests of three eggs each.

Gelochelidon nilotica. Gull-billed Tern. Cockroach Cay: July 12, 1940, about 50 birds occupied a ridge and I counted ten nests with two downy young in each. The nests were cups in a bed of short grass quite close to a nesting colony of Royal Terns.

Sterna hirundo hirundo.—Common Tern. St. Croix: On September 26 and again on October 15, 1939, a flock of eighteen common terns was encountered on their feeding grounds two miles offshore. I collected two specimens, one of which had been banded on June 9, 1938, at Penikese Island, Massachusetts, by Dr. O. L. Austin. This is a new record.

Sterna dougallii dougallii.—Roseate Tern. St. Thomas: A colony of 200 nested on coastal cliffs at Bivoni Bay and had downy young on June 26, 1939. At Little Saba Cay a colony of 200 was found nesting on the cliffs on July 2, 1940.

Sterna anaethetus melanoptera.—Bridled Tern. Flat Cay and Little Saba Cay: A colony of 200 birds were nesting and downy young and some eggs were noted on June 26, 1940. Each nest contained a single egg placed on bare earth under shrubbery.

Sterna fuscata fuscata.—Sooty Tern. Dove Cay, Flat Cay, Little Saba Cay: A colony of 100 terns was caring for downy young and incubating late eggs on June 26, 1940. The single egg in each nest was resting on bare earth under protective shrubbery.

Thalasseus maximus maximus.—Royal Tern. Cockroach Cay: July 12, 1940. A colony of 40 adults was found caring for downy young having either one or two young in each nest.

Anous stolidus stolidus.—Noddy. The noddy starts nesting early in June. Colonies of from 100 to 500 birds were found nesting on Cock-

roach, Little Saba, Flat Cay and Ginger Island. The single egg is deposited on the bare rock-ledge, usually in a cliff facing.

Oreopeleia mystacea beattyi.—Quail-dove. St. John: March 13, 1940. Several specimens were collected. This is a new discovery in the fauna of the island. Tortola, B. V. I.: March 15, 1941. Specimens taken also constitute a new discovery for Tortola and will likely prove to be the most easterly limits in the range of *beattyi.*

Protonotaria citrea.—Prothonotary Warbler. St. Croix: A male was collected on October 6, 1940. Grange Swamp. A new record.

Helmitheros vermivoros.—Worm-eating warbler. St. Croix: On October 31, 1940, two specimens were taken on Mt. Eagle, and another was seen on April 9, 1941. A new record.

Dendroica breviunguis.—Black-poll Warbler. St. Croix: About fifteen of these warblers were observed in an extensive field overgrown with thorny acacia, first on October 23, 1940, and thereafter at intervals for two weeks. Several specimens were taken. A new record.

Dendroica discolor collinsi.—Florida Prairie Warbler. St. Croix: Among a number of warbler skins sent to Dr. Bishop was one specimen which he identified as this form. It was taken on October 24, 1940. A new record.

Wilsonia citrina.—Hooded Warbler. St. Croix: A male bird was collected on March 16, 1941. It was flitting amongst undergrowth following a streamway when first observed. This is a new record.

ACKNOWLEDGMENTS

On all my visits to the islands and cays in the Virgin Islands group the greatest difficulty was transportation. For assistance in making these arrangements and other courtesies it is a pleasure to mention my gratitude to various people.

To The Honorable Robert M. Lovett, Acting Governor of the V. I., U. S. A., for his kindly interest in my plan to continue scientific investigations of local faunas. Mr. M. F. de Castro, Commissioner of Finance, expedited the issuance of collecting permits. Mr. D. Boreham, Superintendent of Public Works, gave material assistance on several occasions. Norman Grigg gave unstintingly of his time and captained his very seaworthy power-boat on several trips, adding greatly to the success of sea bird collecting. Mr. R. Nichols, Director of the Extension Station, also assisted me and his knowledge of local birds was of value. I was very much impressed by the excellent collection of eggs of Virgin

Islands birds which Mr. Nichols has brought together. Among them is a set of three eggs of the rare little owl, *Otus nudipes newtoni*, collected on St. Thomas in May 1936. The eggs are snowy white in color. I shall remember the kindnesses of Dante de la Garde who stands alone in the interest of conservation on that island. He needs cooperation if the ruthless traffic in eggs and, especially, the young of all sea birds and game birds is to be stamped out. Thanks are due Desmond Fabio for his hospitality and much oral information about the cays.

I must mention His Honour D. P. Wailing, Commissioner of Tortola, B. V. I., for his gracious consent in granting permits for collecting on that island and his deep interest in my findings. And Mr. Roy, Director of the Botanical Station, who joined me on several excursions, his knowledge of the island and of the people rendering collecting a simpler task.

Special thanks are due Senor V. Balbas Peña, of San Juan, for an invitation to join a party of friends vacationing among the islands on his motor cruiser *"Malola."* During the trip there were abundant opportunities for ornithological observations in which I was ably assisted by the enthusiasm and alertness of shipmates Julio Rodriguez and Guillermo Margaridas, of San Juan, and Anton C. Teytaud, of St. Croix.

NEW COLEOPTERA FROM PUERTO RICO

By W. S. Fisher

Bureau of Entomology and Plant Quarantine, United States Department of Agriculture

Among a small collection of Coleoptera submitted for identification from Puerto Rico by George N. Wolcott, the following two interesting new species were found. L. F. Martorell, who is making an insect pests survey of the forest trees of Puerto Rico, is anxious to have names for the species to be used in a paper dealing with the insects of that region.

Family ANOBIIDAE

Catorama neltumae, new species

Oblong-oval, strongly convex, moderately shining, uniformly black above, slightly more brownish beneath, with the antennae and tarsi yellowish, rather densely clothed with short, recumbent, more or less silky, whitish pubescence, which does not conceal the surface. Head and pronotum confluently punctate, with fine and coarse punctures intermixed. Elytra finely, densely punctate, with numerous, irregularly arranged, coarse punctures; each elytron with two rather deep lateral striae extending from middle of elytron to apex, but obliterated basally. Anterior tibia unisulcate externally. Middle tibia without a marginal groove. Metasternum not carinate anteriorly, rather sparsely, coarsely, uniformly punctate over entire surface.

Length 3.5 mm., width 2 mm.

Type Locality.—Guanica, Puerto Rico.

Type and Paratypes.—In the United States National Museum No. 55676. Paratypes in the Agricultural Experiment Station, Rio Piedras, Puerto Rico.

Described from ten specimens collected during December 1940 from seed pods of mesquite, "*Neltuma juliflora*," by L. F. Martorell (P. R. Acc. No. 812–40).

This species is related to *Catorama herbarium* Gorham but differs from that species in being uniformly black on the dorsal surface of the body, in having the pubescence on the pronotum and elytra finer and

more silky, the punctures on the elytra irregularly distributed and not arranged in rows, the lateral striae extending only to the middle of the elytron, and the anterior tibia with only one longitudinal sulcus.

FAMILY CERAMBYCIDAE

Trypanidius nocturnus, new species

Female.—Broadly elongate, moderately convex above, uniformly dark reddish brown, the elytra ornamented with black and yellowish-white pubescent markings.

Head in front flat, longer than wide, rather broadly concave between the antennal tubercles, which are widely separated and slightly elevated; surface finely, densely punctate, densely clothed with short, recumbent, brownish and yellowish pubescence, with a distinct longitudinal groove extending from occiput to clypeus. Eyes large, not coarsely granulated, deeply emarginate, separated from each other on the top by about one-half the width of the emargination of the eye; lower lobe subquadrate; upper lobe narrow. Antenna as long as body, densely clothed with short, recumbent, brownish pubescence, with a few inconspicuous white hairs intermixed, the segments narrowly annulated with whitish pubescence at bases; first segment slender, subcylindrical, gradually expanded to apex, extending to base of pronotum, one-fourth longer than third segment, which is distinctly longer than fourth.

Pronotum distinctly wider than long, slightly narrower at apex than at base, widest at middle; sides obliquely expanded from apical angles to a short, acute tubercle on each side just behind middle, then obliquely converging to the posterior angles; surface moderately convex, slightly uneven, broadly, transversely depressed along base, with a slightly elevated, rounded gibbosity at middle, in front of which is a round depression, and with a transverse row of coarse, deep punctures in basal depression, densely clothed with short, recumbent, dark-brown and yellowish-brown pubescence, and ornamented with five brownish-black pubescent spots, one median and two on each side. Scutellum elongate-triangular, slightly concave, densely clothed with brownish-black pubescence at sides.

Elytra distinctly wider than pronotum; sides gradually, obliquely converging from humeral angles to apical fifth, then strongly, arcuately converging to the tips, which are separately obtusely angulated; surface sparsely, coarsely, irregularly punctate basally, more finely, sparsely apically, densely clothed with short, recumbent, dark-brown and yellowish-brown pubescence, with longitudinal rows of inconspicuous white pubes-

cent spots. Each elytron ornamented with a slightly oblique black pubescent spot along sutural margin behind scutellum, and a similar colored, narrow, arcuate one behind middle, and with a narrow, short, longitudinal, yellowish-white pubescent vitta at base and a large, triangular, yellowish-white pubescent spot covering apical fourth.

Body beneath finely, indistinctly punctate, rather densely clothed with short, recumbent, inconspicuous pubescence, with numerous irregular, yellowish pubescent spots; last abdominal sternite broadly subtruncate at apex; prosternal process one-half as wide as coxal cavities, nearly flat at middle, with sides slightly elevated; mesosternum as wide as coxal cavities, broadly triangular, sides elevated, declivous in front, slightly emarginate posteriorly; femora strongly clavate.

Length 15 mm., width 6 mm.

Type Locality.—Villalba, Puerto Rico.

Type.—In the United States National Museum, No. 55677.

Described from a single female collected at light, May 18, 1940, by L. F. Martorell (P. R. Acc. No. 789–40).

This species is allied to *Trypanidius insularis* Fisher described from Cuba, but differs from that species in being more reddish brown and in having a large, triangular, yellowish-white pubescent spot covering the apical fourth of each elytron replacing the transverse, white, zigzag fascia on the elytron of *insularis*.

STUDIES ON THE MOSAIC OF PEPPERS (*CAPSICUM FRUTESCENS*) IN PUERTO RICO

BY ARTURO ROQUE AND JOSÉ ADSUAR

INTRODUCTION

A mosaic disease of peppers causing stuntiness of the plant and severe malformation of the fruit appeared in epidemic form about three years ago in the Agricultural Experiment Sub-station at Isabela. Since then it has spread with great rapidity and intensity throughout that region and has also been found causing serious damage in other important vegetable sections of the island. Serrano and Riollano (6) estimated the crop losses due to mosaic for Isabela from 50 to 60 percent in the season of 1938 and stated that further plantings were, in their opinion, a risky proposition.

The first report of pepper mosaic in Puerto Rico known to the writers is that made by Cook (2) in 1927–28. Since then, no effort has been made to study the disease and to determine the virus or viruses involved.

In connection with a breeding program to develop a commercial variety of peppers resistant to mosaic, studies to determine the prevalence, distribution, properties of the virus and varietal susceptibility were undertaken. The experiments were conducted in the Agricultural Experiment Station at Rio Piedras during the years 1939–41.

MATERIALS AND METHODS

All plants used for inoculation purposes were grown in sterilized compost soil in 5 inch pots. The plants were kept in a section of the greenhouse screened with 24-mesh copper wire. As an additional precautionary measure the plants were periodically sprayed to prevent, as far as possible, accidental infections due to insect vectors. Inoculations were made when the plants had developed 3 or 4 pairs of leaves and were actively growing. Although the ordinary methods of mechanical transmission were found satisfactory, the brush method was developed and adopted for its practicability. This method consists in the use of a flat artist brush (Mikado No. 5) with bristles cut to a length of about ½ inch. The brushes can be used over and over again after sterilization

in boiling water for fifteen minutes or more and are very convenient for large scale inoculations. Inoculations were performed by gently rubbing the upper surface of two or three of the youngest leaves with a brush that had been dipped in the extract.

The inoculum was obtained by crushing infected leaves in a sterile mortar with sterile sand and water. The resulting macerate was strained through cheese cloth and used without further treatment.

FIG. 1. Young pepper plants of the variety King of the North showing symptoms of pepper mosaic. Plants at left and right inoculated; middle plant, check. Note stunting, mottling and malformation of infected plants.

The longevity "in vitro" was determined by aging the extract in stoppered test tubes for the desired length of time. The thermal inactivation point was determined by immersing 5 cc. of the extract in thin walled test tubes in a water bath.

Pure cultures of the viruses, for inoculation and other studies, have been kept in young pepper and tobacco plants grown in cages. The potato mottle virus (ring spot strain) and the potato vein banding virus were kindly supplied by Prof. J. Johnson of Wisconsin University. The ordinary tobacco mosaic virus and the cucumber mosaic virus were obtained locally from infected tobacco and cucumber plants.

The commercial varieties of peppers California Wonder and Large Bell Hot, the variety Mirasol (a South American hot pepper) and *Nicotiana glutinosa* were used as differential hosts in these studies.

All inoculations were repeated at least three times in lots of ten plants.

The insect transmission studies were conducted by submitting healthy pepper plants grown free from insects to the attack of aphids feeding on plants inoculated with the pepper mosaic virus.

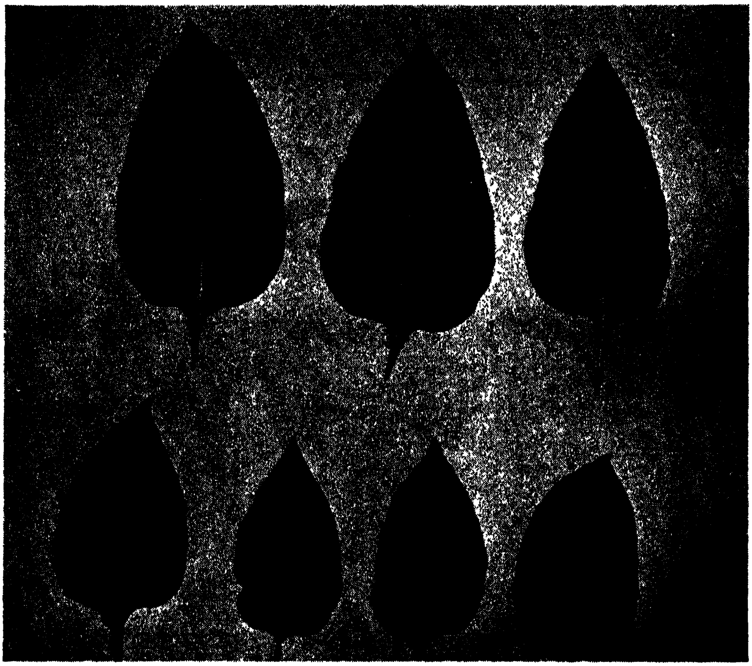


FIG. 2. Infected leaves of two varieties of pepper showing characteristic symptoms of pepper mosaic. Upper and lower left leaves uninoculated. Note vein-clearing, mottling and vein-banding.

The immunological relationship between the pepper mosaic virus and other viruses was determined by inoculating the Large Bell Hot variety with the following: Solanum 1 and 2, ordinary tobacco mosaic and cucumber mosaic viruses. After symptoms appeared, the affected plants were reinoculated with the pepper mosaic virus.

SYMPTOMS

All susceptible varieties of pepper studied with the exception of the Large Bell Hot, present the following symptoms when infected with the virus causing mosaic: in about 10–12 days after inoculation a marked clearing of the veins develops in the upper younger leaves, followed later by a systemic mottling which, in a majority of cases, ends in a definite vein banding. This last symptom is very characteristic of the mosaic produced by this virus and helps to identify it in the field. In addition

FIG. 3. Young pepper plants of the Large Bell Hot variety inoculated with pepper mosaic virus. Left and right plants inoculated; middle plant, check. Note systemic vein necrosis and leaf shedding.

to the mottling, the leaves become wrinkled and the whole plant is stunted, especially if the infection has taken place early in the development of the plant. Fruit setting is curtailed and those that develop after the symptoms have appeared are undersized, mottled and badly distorted.

The severity of the disease bears a relation to the age of the plants at the time of inoculation—young plants are more seriously and rapidly affected than old plants.

The variety Large Bell Hot is a hot pepper of medium, square shaped fruits. In young, actively growing plants of this variety the virus pro-

duces a systemic vein necrosis in from 5–6 days, followed by defoliation, stem streaking and death of the entire plant. These symptoms develop more slowly in the old plants. The characteristic mottling and vein banding do not develop. As no other variety so far studied reacts in this way to this virus, it serves as an excellent host for identification purposes as well as for other studies.

FIG. 4. Young pepper plants of the Large Bell Hot variety inoculated with pepper mosaic virus showing advanced stage of the infection. Left and right plants inoculated; middle plant, check. Note defoliation, stem streaking and death.

DISTRIBUTION AND PREVALENCE

The disease is widely spread throughout the island and has been found in almost every place where peppers are grown.

The prevalence of the virus in fields infected with mosaic was determined by sampling at random diseased plants and inoculation into the "Mirasol" variety of pepper. The variety "Mirasol" was used because it reacts with localized necrosis to the *Nicotiana* virus 1, thus differentiating between the virus under study and the ordinary tobacco mosaic virus which is widely distributed throughout the island. In seven areas surveyed, its presence ranged from 60 to 95 percent in the plants with mo-

saic. Tobacco mosaic was found on three of the seven areas and only to an extent of from 1–3 percent of the diseased plants.

PROPERTIES OF THE VIRUS

Transmission.—Transmission is easily accomplished by the usual mechanical methods. Evidence of transmission by the aphids *Myzus persicae,* Sulz., has also been obtained.

Aging "in vitro."—Freshly prepared extract stored in test tubes at a room temperature of 22° C., kept its infectivity up to 24 hours and was completely inactivated after 48 hours.

Thermal Inactivation.—To determine the heat resistance of the virus, 5 cc. of the extract was placed in thin test tubes and heated in a water bath at the desired temperature for 10 minutes. The heated extract was rapidly cooled in iced water and immediately inoculated in the test plants. Infections were obtained with extract heated up to 55° C., but no reaction was obtained with extract heated to 58° C. or more.

Dilution.—The effect of dilution on the infectivity of the virus was determined by diluting the fresh extract with sterile water. The dilution end point is low, infectivity begins to fall rapidly at dilutions of 1–80 and infections were only occasionally obtained at dilutions of 1–100.

IMMUNOLOGICAL RELATIONSHIPS

To determine the possible relationship between the virus responsible for the pepper mosaic in Puerto Rico and such common viruses as the tobacco virus 1, cucumber virus 1 or their strains, and viruses of the Solanum group 1 and 2 which are known to attack peppers in nature, cross inoculation studies were made. The variety of pepper Large Bell Hot, because of its typical systemic vein necrosis reaction was used. Plants reacted as follows when inoculated: chlorosis and mottling with ordinary tobacco mosaic and cucumber viruses, mottling with Solanum virus 1 and localized necrotic spots with Solanum virus 2.

The results demonstrated that the four above mentioned viruses were unable to immunize or protect invaded tissues of the Large Bell Hot pepper against infection by subsequent inoculation with the virus under study.

HOST RANGE

In an attempt to determine if the virus was limited in its range to the genus *Capsicum* and at the same time to study its host relationships

within the *Solanaceae,* efforts to reproduce the disease in other members of this family were made. Out of eighty-four varieties of the genus *Capsicum,* including commercial and non-commercial varieties, only two have been found resistant to the virus. A strain of pepper developed by Dr. F. O. Holmes * which reacts with localized necrotic spots when inoculated with the tobacco mosaic virus, reacts with systemic mottling to the Puerto Rico pepper mosaic virus. Among related genera, *Nicotiana glutinosa, N. Tabacum,* var. Virginia, *N. Bigelovii,* var. *multivalvis, N. Bigelovii* var. *quadrivalvis* and *N. rustica,* developed symptoms when inoculated with the new virus (See Table I). *Solanum melongena* var.

TABLE I. *Symptoms developed on different hosts by the Puerto Rico pepper mosaic virus when inoculated artificially*

HOST	SYMPTOMS
Capsicum frutescens, var. Large Bell Hot	Vein clearing, systemic vein necrosis, defoliation, stem streak, death
C. frutescens, var. California Wonder	Vein clearing, mottling, vein banding, stuntiness
Nicotiana glutinosa	Chlorosis, vein clearing, mottling
N. Tabacum, var. Virginia	Vein clearing, chlorotic spots, vein banding
N. Bigelovii, var. *multivalvis*	Vein clearing, ring spots
N. Bigelovii, var. *quadrivalvis*	Vein clearing, ring spots
N. rustica	Vein clearing, mottling, vein banding

Puerto Rican Beauty and *Lycopersicum esculentum,* var. Marglobe, occasionally developed symptoms, but failed to indicate the presence of the virus when tested back to a differential host like the Large Bell Hot pepper. *Solanum tuberosum, S. nodiflorum, Datura stramonium, N. sylvestris,* and *N. repanda* failed to develop symptoms when inoculated. *Cucumis sativus, Phaseolus vulgaris* and *Phaseolus lunatus* did not react to the virus.

DISCUSSION

The nature of the virus causing pepper mosaic in Puerto Rico is not known. A study of the literature dealing with pepper mosaic reveals that several viruses are capable of infecting the genus *Capsicum* in nature.

* Seed of this strain, a semi-commercial variety of peppers, was kindly supplied by F. O. Holmes of the Rockefeller Institute for Medical Research, Princeton, N. J.

J. Johnson (5) described eight out of eleven viruses studied as causing definite symptoms in peppers. Blodgett (1) was able to produce a serious disease of peppers by inoculating with the virus causing mottle in tobacco (Solanum 1). E. M. Johnson (4) found peppers susceptible to eighteen of the viruses attacking tobacco in Kentucky. K. M. Smith (7) listed eight viruses capable of infecting peppers. Holmes (3) recorded twelve pathogenic viruses on peppers. A comparison of the properties and symtoms of the viruses causing pepper mosaic elsewhere and the one from Puerto Rico is presented in the following table.

With the possible exception of the potato vein banding virus (virus Y), the viruses reported differ widely from the Puerto Rico pepper virus not only in physical properties, but in many cases in symptoms as well. The vein banding virus, however, is very similar in physical properties to the virus here reported. The symptomatology, nevertheless, is very different from that produced by our virus. In the Large Bell Hot variety the vein banding virus produces necrotic spots, wrinkleness and blight while the pepper virus produces a distinct systemic vein necrosis which is always fatal. The difference in symptom expression, however, is not sufficient in itself to establish relationship between the viruses.

Plants of the Large Bell Hot variety inoculated with the vein banding virus and showing symptoms were reinoculated with the virus causing pepper mosaic in Puerto Rico. The typical systemic vein necrotic symptoms of this differential host developed, showing that the former virus offered no protection to infection by our virus and, therefore, that the two viruses were not closely related.

As far as the writers know the potato mild mosaic virus (potato virus A) has not been reported attacking peppers. Its physical properties, however, closely resemble those of the pepper virus from Puerto Rico and since the symptoms described on *N. tabacum* are also similar it may be possible that they might be related. Unfortunately, the writers have been unable to obtain a pure culture of this virus for comparative studies.

With the possible exception of the ordinary tobacco mosaic virus, no other virus has been reported causing serious and widespread damage to commercial plantings of peppers. The virus here reported, however, causes a disease of considerable importance in our commercial fields and is widely distributed in Puerto Rico. All commercial varieties of peppers so far tested and a large number of non-commercial, ornamental and hot types are susceptible to this virus. It thus appears, that the virus,

TABLE II. *Symptoms and properties of the viruses reported as capable of infecting peppers*

VIRUS	SYMPTOMS ON *Capsicum frutescens*	PHYSICAL PROPERTIES			IMMUNOLOGICAL REACTION WITH PUERTO RICO PEPPER MOSAIC VIRUS
		AGING	THERMAL DEATH-POINT	DILUTION	
Puerto Rico pepper mosaic virus	Mottling, vein banding, stuntiness, distortion	24–48 hrs.	55° C.–58° C.	1–100	
Tobacco mosaic virus—Typical strain	Chlorosis, mottling, necrosis, stuntiness	Indefinite	93° C.	1–1,000,000	Negative
Tobacco mosaic virus—Masked symptom strain	Mottling	Indefinite	90° C.	1–1,000,000	Undetermined
Tobacco Etch virus—Typical strain	Mottling, chlorosis, stuntiness, distortion	—	—	—	Undetermined
Cucumber mosaic virus—Typical strain	Malformation, chlorosis, stuntiness	72–96 hrs.	60° C.–70° C.	1–10,000	Negative
Cucumber mosaic virus—Southern celery mosaic strain	Mottling, necrosis, stuntiness	14 days	75° C.–80° C.	1–100,000	Undetermined
Cucumber mosaic virus—Lima bean mosaic strain	Stuntiness, chlorotic spots	8 days	70° C.	1–10,000	Undetermined
Cucumber mosaic virus—Potato vein banding strain	Necrotic spots, wrinkleness, leaf blight	24–36 hrs.	52° C.	1–100	Negative
Potato mottle virus—Typical strain	Chlorotic spots, necrosis defoliation	Over 28 days	70° C.	1–100,000	Undetermined
Potato mottle virus—Potato ring spot strain	Systemic necrosis	Over 28 days	68° C.	1–10,000	Negative
Potato mottle virus—Masked mottle strain	Systemic necrosis	—	—	—	Undetermined
Potato Aucuba mosaic virus	Chlorotic spots, mottling distortion, leaf drop	Less than 4 days at 15° C.	65° C.	1–200	Undetermined
Tomato spotted wilt virus—Typical strain	Mottle	Less than 5 hrs.	42° C.	1–100,000	Undetermined
Tomato streak virus	Mottling, chlorosis	Indefinite	85° C.–90° C.	—	Undetermined
Tomato ring mosaic virus	Chlorotic rings, distortion, stuntiness	—	80° C.	—	Undetermined
Tomato bunchy top virus	Symptomless carrier	12–24 days	70° C.	—	Undetermined
Sugar Beet curly—top virus	Vein clearing, curling	Over 7 days	75° C.–80° C.	1–1,000	Undetermined

although successfully transmitted to other members of the *Solanaceae,* is largely confined to the genus *Capsicum* in Puerto Rico.

Based on a survey of the literature available and the evidence presented, the virus under discussion may be some described form thus far not reported attacking peppers, or an entirely undescribed entity.

SUMMARY

A serious mosaic disease of peppers in Puerto Rico is reported. The disease is widely spread throughout the island and causes mottling of the foliage, stuntiness of plant and malformation of the fruit.

The virus responsible for the disease is easily transmitted mechanically. Evidence of transmission by the aphid *Myzus persicae* has been obtained. The virus is inactivated "in vitro" after 48 hours. The thermal inactivation point ranges from 55° to 58° C. Infectivity falls rapidly at dilutions of 1:80 and infections are only occasionally obtained at dilutions of 1: 100.

No immunological relationship was found between the virus causing mosaic of peppers in Puerto Rico and the potato mottle virus (ring spot strain), the potato vein banding virus, the ordinary tobacco mosaic virus and the cucumber mosaic virus.

Out of eighty-four varieties of peppers studied only two were found resistant to the virus. *Nicotiana tabacum, N. glutinosa, N. Bigelovii* var. *multivalvis, N. Bigelovii* var. *quadrivalvis,* and *N. rustica* reacted when inoculated with the virus. *Solanum nodiflorum, S. tuberosum, Datura stramonium, Nicotiana repanda* and *N. sylvestris* failed to develop symptoms when inoculated. *Cucumis sativus, Phaseolus vulgaris* and *P. lunatus* did not react to the virus.

The studies suggest that the virus causing pepper mosaic in Puerto Rico is either a described form thus far not reported attacking peppers, or an undescribed entity.

LITERATURE CITED

1. **Blodgett, F. M.** A potato virus on peppers. Phytopath. **17**: 775–782, 1936.
2. **Cook, M. T.** In Annual Report Ins. Expt. Sta., Dept. of Agri. and Labor of Puerto Rico. Fiscal Year **1927–28**: 65, 1929.
3. **Holmes, F. O.** Handbook of phytopathogenic viruses. Burgess Publishing Co. Minneapolis. 221 p., 1939.

4. **Johnson, E. M.** Virus diseases of tobacco in Kentucky. Kentucky Agr. Expt. Sta. Res. Bul. **306**: 415 p., 1930.
5. **Johnson, J.** The classification of plant viruses. Agri. Expt. Sta. Univ. Wisconsin Res. Bul. **76**, 16 p., 1927.
6. **Serrano, L. A.** and **A. Riollano.** Letter. 1938.
7. **Smith, K. M.** A textbook of plant virus diseases. J. & A. Churchill Ltd. London, 615 p., 1937.

GERMINATION FAILURES OF THE MAGNOLIA IN PUERTO RICO

By Melville T. Cook

During the summer of 1936 Mr. L. R. Holdridge of the U. S. Forestry Service called my attention to germination failures of *Magnolia portoricensis* Bello. This and the very closely related species *M. splendens* Urban produce exceptionally fine woods but unfortunately both species are being exterminated very rapidly. Both species were very abundant at one time but at the present, it is practically impossible to find young trees in the forest. The Forestry Station has been trying to overcome his difficulty by sowing seeds in seed beds and growing seedlings for transplanting. Up to the present only one seedling of *M. borinquensis* has been produced although thousands of seeds have been sown.

When the first lot of material was brought to the writer it was found that the seeds in the pods were surrounded by masses of a white fungus mycelium and appeared to be packed in cotton. It was very naturally assumed that this fungus might be the important factor in the poor germination. The seeds from these pods were found to be dead but the fungus could not be detected on the inside.

However, it was noted that many seeds had never matured. Some of them were very small black scales, while others had attained a somewhat larger growth and then stopped before attaining full size. Therefore it was decided to make a study of the development of the embryo sac and embryo. A large number of seeds were sectioned in paraffin.

It was found that many of these ovules never developed an embryo sac. Others developed empty sacs. Whether they were really empty or appeared so as a result of faulty technique has not been determined. Most of the large seeds developed large sacs which were filled with an endosperm but the development has not been traced. Only three embryos have been found and in all cases the seeds were in an advanced stage of development and the two small embryos were in much larger seeds than the large embryo.

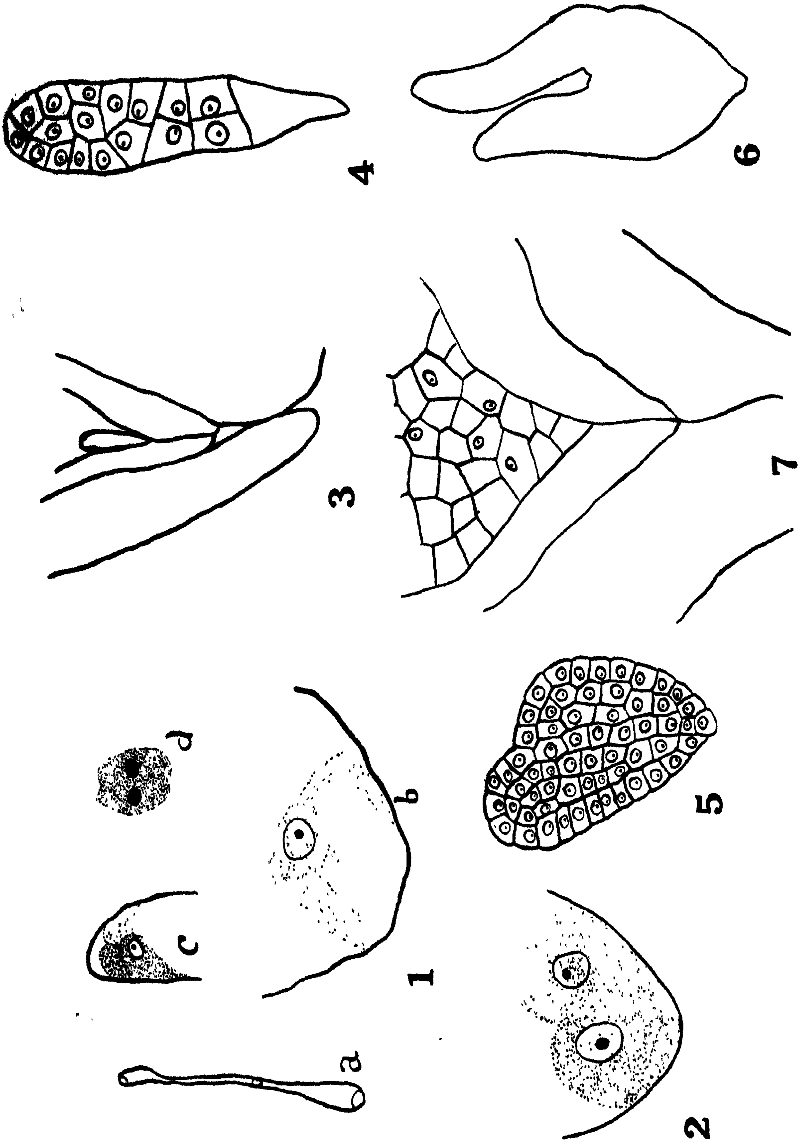
The pollen appeared to be normal.

The *M. splendens* has not been studied by the writer but young trees are as rare for this species as for *M. portoricensis.*

This problem presents several questions. Why are such a small number of embryos produced? Undoubtedly the behavior of this species must have been quite different in the past otherwise it could not have been as abundant as it has been until very recently. It lost the power of producing viable seeds? If so, why?

EXPLANATION FOR FIGURE ON PAGE 53

1. Embryo sac about ½ length of ovule.
2. Egg from same immersion.
3. Ant from same immersion.
4. Polars from same immersion.
5. Egg and one synergid.
6. Embryo in position.
7. Embryo in position.
8. Embryo in position.
9. Embryo in position.
10. Micropyle end of large seed almost mature. There is no embryo but the entire embryo sac was filled with a mass of endosperm.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